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SELECTED WATER RESOURCES ABSTRACTS

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As the Nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural resources. This includes fostering the wisest use of our land and water resources, protecting our fish and wildlife, preserving the environmental and cultural values of our national parks and historical places, and providing for the enjoyment of life through outdoor recreation. The Department assesses our energy and mineral resources and works to assure that their development is in the best interests of all our people. The Department also has a major responsibility for American Indian reservation communities and for people who live in Island Territories under U.S. administration.

PREFACE

Selected Water Resources Abstracts, a monthly journal, includes abstracts of current and earlier pertinent monographs, journal articles, reports, and other publication formats. These documents cover water resources as treated in the life, physical, and social sciences and the related engineering and legal aspects of the characteristics, supply condition, conservation, control, use, or management of water resources. Each abstract includes a full bibliographic citation and a set of descriptors which are listed in the **Water Resources Thesaurus.** The abstract entries are classified into 10 fields and 60 groups similar to the water resources research categories established by the Committee on Water Resources Research of the then Federal Council for Science and Technology.

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Comments and suggestions concerning the contents and arrangement of this bulletin are welcome.

Water Resources Scientific
Information Center
U.S. Geological Survey
MS 425 National Center
Reston, VA 22092

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W87-01875

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W87-01898

TIME SERIES ANALYSIS IN PERSPECTIVE,
Waterloo Univ. (Ontario). Dept. of Systems Design Engineering.
K. W. Hipel.
Water Resources Bulletin WARBAQ, Vol. 21, No. 4, p 609-624, August 1985. 2 fig, 2 tab, 76 ref.

Descriptors: *Time series analysis, *Mathematical studies, *Model studies, Data analysis, Environmental impact assessment, Model classification, Stochastic hydrology.

By employing a set of criteria for classifying the capabilities of time series models, recent developments in time series analysis are assessed and put into proper perspective. In particular, the inherent attributes of a wide variety of time series models and modeling procedures are described. Additionally, it is explained how these models can address many of the time series problems encountered when modeling hydrologic, water quality and other kinds of time series. For instance, families of time series models are available for modeling series which may contain nonlinearities or may follow non-Gaussain distributions. Based upon a sound physical understanding of a problem and results from exploratory data analyses, the most appropriate model to fit to a data set can be found during confirmatory data analyses by following the identification, estimation and diagnostic check stages of model construction. Promising future research projects for developing flexible classes of time series models for use in water resources applications are suggested. Selecting a suitable stochastic model to fit to a time series can be considered as both an art and a science. (Peters-PTT)
W87-01900

PAST AND FUTURE OF ANALYSIS OF WATER RESOURCES TIME SERIES,
George Washington Univ., Washington, DC. International Water Resources Inst.
V. Yevjevich, and N. B. Harmancioglu.
Water Resources Bulletin WARBAQ, Vol. 21, No. 4, p 625-633, August 1985. 4 fig, 12 ref. NSF Grant CEE 8405289/8541631.

Descriptors: *Mathematical studies, *Time series analysis, *Stochastic hydrology, Supply and demand series, Water resources development, Water storage.

Water resources supply and demand time series consist of several or all of the four basic characteristics: tendency, intermittency, periodicity and stochasticity. Their importance changes from one type of variables to another. A bridge needs to be made between the general methods of mathematics and the methods of finding the physically-consistent properties of any particular series. Time series analysis in hydrology and water resources has not always consisted of a joint use of statistical and physical approaches. The history of evolution of investigative methods proves a general picture on where the state-of-the-art of analysis is at present. Historic developments of analysis of time series in hydrology have varied significantly over the past, from the stress on search for periodicities and persistence in annual series to the emphasis on the series stochastic properties. Supply and demand series are often highly interrelated, which fact is most often neglected in planning water resources systems in general, and water storage capacities in particular. The future of series analysis in water resources will likely be by a joint use of physically-based structural analysis and the use of advanced methods of treating data by stochastic processes, statistical estimation and inference techniques. The most intriguing challenge of the future of this analysis may be the treatment of nonnormal, nonlinear and in general nonstationary hydrologic and water use time series. The proper treatment of complex multivariate processes will also challenge the specialists, especially for the purposes of transfer of information between data on variables at given points, or between data at several points of a given variable, or both. (Peters-PTT)
W87-01901

SOME SIMPLE MODELS FOR CONTINUOUS VARIATE TIME SERIES,
Naval Postgraduate School, Monterey, CA.
P. A. W. Lewis.
Water Resources Bulletin WARBAQ, Vol. 21, No. 4, p 635-644, August 1985. 54 ref. Office of Naval Research NR042-469.

Descriptors: *Model studies, *Time series analysis, *Mathematical studies, Exponential models, Gamma models, Weibull models, Laplace models, Beta models, Non-Gaussian time series.

A survey is presented of some recently developed models for continuous variate non-Gaussian time series. Exponential, Gamma, Weibull, Laplace, Beta and Mixed Exponential models are considered for the marginal distributions of the stationary time series. The emphasis is on models which are simple and flexible in the following senses: the models should be specified in terms of easily observed and measured quantifiers; the models should be parametrically parsimonious and parametrically simple; the models should be easy to generate on computers; and the models should be easy to fit to data, both formally and informally. Most of the models are random coefficient, additive linear models. Some discussion of the meaning of autoregression and linearity is given, as well as suggestions for higher-order residual analysis for non-Gaussian models. No attempt has been made to completely survey all the models for continuous variate time series which have been proposed. (Peters-PTT)
W87-01902

SOME SIMPLE MODELS FOR DISCRETE VARIATE TIME SERIES,
University of Strathclyde, Glasgow (Scotland). Dept. of Mathematics.
E. McKenzie.
Water Resources Bulletin WARBAQ, Vol. 21, No. 4, p 645-650, August 1985. 23 ref.

Descriptors: *Model studies, *Time series analysis, *Mathematical studies, Poisson ratio, Geometric distribution, Negative binomial distribution, Binomial distribution, Time-dependent behavior, Hydrology, Seasonal variation.

Simple models which can be used easily for either the modelling or the generation of dependent sequences of discrete random variates are reviewed. The models are all first order autoregressive processes. Most of them, however, can be extended to alternative forms of dependence. A feature of the models is the specification of their marginal distributions as an intrinsic component. In particular, the Poisson, Geometric, Negative Binomial, and Binomial distribution are discussed, and models for each presented. Some of the properties of each model are noted and the extension to higher order and alternate forms of dependence discussed. Methods of introducing time-dependent behavior into the models in order to deal with seasonality are presented in detail. This is of particular interest in hydrology, since almost all data there is heavily influenced by seasonal variation. The structure of the models presented here allows an easy introduction of time-dependence in a natural way. (Peters-PTT)
W87-01903

THRESHOLD TIME SERIES MODELING OF TWO ICELANDIC RIVERFLOW SYSTEMS,
Chinese Univ. of Hong Kong, Shatin. Dept. of Statistics.
H. Tong, B. Thanoon, and G. Gudmundsson.
Water Resources Bulletin WARBAQ, Vol. 21, No. 4, p 651-661, August 1985. 7 fig, 1 tab, 14 ref.

Descriptors: *Model studies, *River flow, *Meteorological data collection, Time series models, Precipitation, Temperature, Vatnsdalsa River, Jokulsa River, Iceland geography, Threshold models, Wind, Radiation.

Experiences in building time series models which connect the flows in two Icelandic rivers with the meteorological variables of precipitation and temperature are reported. The geographical and meteorological conditions of the Vatnsdalsa and Jokulsa rivers are, in many aspects, similar. The main characteristic of Vatnsdalsa is direct runoff. The most important difference of the drainage area of Jokulsa eystri as compared with Vatnsdalsa is that it includes a glacier covering 155 sq km out of a total area of 1200 sq km. In areas where precipitation may be either in the form of rain or snow linear models are inadequate to describe the relationship between the river and the meteorological variables. The methodology of threshold models seems to be well suited to whether it is freezing or not. The possibility of identifying an alternative threshold variable is also explored. To a certain extent, the results support the view that threshold models may be suitable. Apart from long-term changes in the geography the flow is completely determined by the weather; there is no feedback detectable on the level of accuracy attainable by actual observations. The estimated models hardly accord with this, however, for the autoregressive coefficients contribute much more to the description of the variations of the rivers than the meteorological variables. The threshold models can only be considered partially successful from the point of view of reducing the data to 'Gaussian white noise'. There are various possibilities of improving upon the modeling. Among these are the introduction of more meteorological variables, such as wind and radiation or precipitation from more than one station. Direct observations of the state of the hydrological system, might be more to the point. With such information appropriate modeling would offer a great deal from the models presented in this paper. However, sharp changes in relations in relationships according to temperature and the presence of snow would still be present. Thresholds in some form could also be convenient for dealing with the nonlinearity in more elaborate models. (Peters-PTT)
W87-01904

STATISTICAL IDENTIFICATIONS OF STORAGE MODELS WITH APPLICATION TO STOCHASTIC HYDROLOGY,
Institute of Statistical Mathematics, Tokyo (Japan).
T. Ozaki.
Water Resources Bulletin WARBAQ, Vol. 21, No. 4, p 663-675, August 1985. 8 fig, 25 ref.

Descriptors: *Model studies, *Stochastic hydrology, *Statistics, *River flow, Time series, Discrete time version, Precipitation, Maximum likelihood method.

Field 2—WATER CYCLE

Group 2A—General

A method for the statistical identification of storage models for daily riverflow time series, together with numerical results, is described. The first step in the identification process is to obtain a discrete time version of a storage model using a local linearization approach. It is shown that the discrete time version thus obtained may be utilized in the identification of the original storage model. A statistical method for the identification of daily rainfall time series models used in simulation is also presented. This identification procedure employs the maximum likelihood method for point process data analysis and is illustrated by means of numerical examples. (Author's abstract)
W87-01905

FRACTIONAL DIFFERENCING MODELING IN HYDROLOGY,
Institute of Hydrology, Wallingford (England).
J. R. M. Hosking.
Water Resources Bulletin WARBAQ, Vol. 21, No. 4, p 677-682, August 1985. 2 fig, 1 tab, 37 ref.

Descriptors: *Time series analysis, *Model studies, *Statistics, Fractional differencing, Long-term dependence, Time series.

The usefulness of fractional differencing to time-series modeling is discussed, with emphasis on hydrologic applications. A methodology for fitting fractionally differenced ARIMA models is described, and examples are presented. Fractional differencing is a tool for modeling time series which have long-term dependence; i.e., series in which the correlation between distant observations, though small, is not negligible. Fractionally differenced ARIMA models are formed by permitting the differencing parameter d in the Box-Jenkins ARIMA (p,d,q) models to take nonintegral values; they permit the simultaneous modeling of the long-term and short-term behavior of an observed time series. In many applications the utility of fractional differencing may be small. The usual ARIMA models can approximate the dependence structure of any finite length of time series and will be adequate for short-term forecasting of individual values. The benefits of fractional differencing may be most evident in long-term prediction, especially in forecasts of long run averages of time series. For many water resources projects the project lifetime will be too short for long-term dependence to be of any importance. The kind of power-law dependence which is modeled by fractional differencing occurs in a wide range of fields of scientific inquiry and seems worth further investigation. (Peters-PTT)
W87-01906

APPROACHES TO MULTIVARIATE MODELING OF WATER RESOURCES TIME SERIES,
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
J. D. Salas, G. Q. Tabios, and P. Bartolini.
Water Resources Bulletin WARBAQ, Vol. 21, No. 4, p 683-708, August 1985. 11 fig, 9 tab, 76 ref. NSF Grant CEE-8110782.

Descriptors: *Stochastic hydrology, *Model studies, *Multivariate analysis, Data generation, Water resources systems, Statistics.

Stochastic techniques for modeling of multivariate time series of inputs and outputs of water resource systems are analyzed and discussed. Alternative approaches suggested for modeling multiseries of water resources systems are reviewed and compared. Most approaches fall within the general framework of multivariate ARMA models. Formal modeling procedures suggest a three-stage iterative process, namely: model identification, parameter estimation and diagnostic checks. Although a number of statistical tools are already available to follow such modeling process, in general, it is not an easy task, especially if high order vector ARMA models are used. However, simpler ARMA models such as the contemporaneous and the transfer-function models may be sufficient for most applications in water resources. Examples of modeling bivariate and trivariate streamflow series are presented. Alternative modeling procedures are used and compared by using data generation techniques. The results suggest that low order models, as well as contemporaneous ARMA models, reproduce quite well the main statistical characteristics of the time series analyzed. It is assumed that the same conclusions apply for most water resources time series. Future developments and applications of aggregation approaches offer a viable alternative for multivariate modeling of water resources time series. (Peters-PTT)
W87-01907

CONTEMPORANEOUS AUTOREGRESSIVE-MOVING AVERAGE (CARMA) MODELING IN WATER RESOURCES,
Alberta Univ., Edmonton. Dept. of Finance and Management Science.
F. Camacho, A. I. McLeod, and K. W. Hipel.
Water Resources Bulletin WARBAQ, Vol. 21, No. 4, p 709-720, August 1985. 6 fig, 4 tab, 49 ref.

Descriptors: *Model studies, *Stochastic hydrology, *River flow, Multivariate models, CARMA models, Estimation of parameters, Multisite hydrology, Unequal sample size.

The Contemporaneous Autoregressive-Moving Average (CARMA) model is a simple and efficient model that can be used to fit many multivariate hydrological time series. For certain types of multistation river flow systems, the CARMA model is naturally obtained when the physical restrictions of the system or the characteristics of the data are taken in consideration during the formulation of the model. It is shown how the CARMA model can optimally be used to handle multiple time series where the number of observations in each series may be different. Adequate model building techniques, as well as computational and statistical efficient algorithms to estimate the parameters of the model, are given. The methodologies and applications of the CARMA model are illustrated with three examples. It is also shown how the full multivariate ARMA model may lead to losses in efficiency of the estimators when the CARMA model is adequate. (Author's abstract)
W87-01908

ASSESSMENT OF REMOTE SENSING INPUT TO HYDROLOGIC MODELS,
Agricultural Research Service, Beltsville, MD. Hydrology Lab.
A. Rango.
Water Resources Bulletin WARBAQ, Vol. 21, No. 4, p 423-432, June 1985. 3 fig, 3 tab, 33 ref.

Descriptors: *Remote sensing, *Water data, *Hydrologic data, *Hydrologic models, *Snowmelt, Model development, Regression models, Snow-cover data.

Past studies are reviewed and present and future usefulness of remote sensing in hydrologic models is evaluated. Remotely sensed variables such as land cover type and snow cover extent can be used directly and effectively in a few specific hydrologic models. Regression models can also be developed using physiographic and snow-cover data to permit estimation of discharge characteristics over extended periods such as a season or year. Most models, however, are not appropriate to readily accept as input the various types of remote sensing parameters that can be obtained now or in the future. Because this new technology has the potential for producing hydrologic data that has significant information content on an areal basis, both inexpensively and repetitively, effort can be devoted to either modifying existing models or developing new models that can use these data. Minor modifications would allow the remote sensing data to be used in an ancillary way to update the model state variables, whereas major structural modifications or new models would permit direct input of the data through remote sensing compatible algorithms. Although current remote sensing inputs to hydrologic models employ only visible and near infrared data, model modification or development should accommodate microwave and thermal infrared data that will be more widely available in the future. (Author's abstract)
W87-01914

DERIVATION OF THE GAMMA DISTRIBUTION BY USING THE PRINCIPLE OF MAXIMUM ENTROPY (POME),
Louisiana Water Resources Research Inst., Baton Rouge.
V. P. Singh, and K. Singh.
Water Resources Bulletin WARBAQ, Vol. 21, No. 6, p 941-952, December 1985. 3 fig, 5 tab, 31 ref.

Descriptors: *Entropy, *Hydrographs, *Unit hydrographs, *Parametric hydrology, *Gamma distribution, Mathematical studies, Least squares method, Maximum likelihood estimation, Method of moments, Method of cumulants, Principle of maximum entropy, Rainfall-runoff events.

The principle of maximum entropy (POME) was used to derive the two-parameter gamma distribution used frequently in synthesis of instantaneous or finite-period unit hydrographs. The method of parameter estimation is compared with the methods of moments (MOM), cumulants (MOC), maximum likelihood estimation (MLE), and least squares (MOLS). The POME yielded the minimally prejudiced gamma distribution by maximizing the entropy subject to two appropriate constraints which were the mean of real values and the mean of the logarithms of real values of the variable. It provided a unique method for parameter estimation. Experimental data were used to compare this method with the methods of moments, cumulants, maximum likelihood estimation, and least squares. POME can be used to derive the two-parameter gamma distribution, provided the two required appropriate constraints are specified. It offers an alternative method for parameter estimation. There exists a unique relationship between MLE and POME methods. For four experimental rainfall-runoff events, the gamma distributions yielded by POME were comparable with those of MOM, MOC, MLE, and MOLS. For these events the peak time was more accurately reproduced by POME than MOM and MOLS but the opposite was true for peak discharge. The recession hydrograph was better reproduced by POME than MOM and MOLS but the opposite was true for the rising hydrograph. (Peters-PTT)
W87-01929

APPROACH TO PARAMETER ESTIMATION AND STOCHASTIC CONTROL IN WATER RESOURCES WITH AN APPLICATION TO RESERVOIR OPERATION,
California Univ., Davis. Dept. of Land, Air and Water Resources.
For primary bibliographic entry see Field 2E.
W87-02269

HURST BEHAVIOR OF SHIFTING LEVEL PROCESSES,
Colorado State Univ., Fort Collins. Dept. of Statistics.
For primary bibliographic entry see Field 4A.
W87-02276

ASSESSMENT OF THE INSTANTANEOUS UNIT HYDROGRAPH DERIVED FROM THE THEORY OF TOPOLOGICALLY RANDOM NETWORKS,
Geological Survey, Lakewood, CO. Water Resources Div.
For primary bibliographic entry see Field 2F.
W87-02282

RESERVOIR MANAGEMENT AND OPERATIONS MODELS: A STATE-OF-THE-ART REVIEW,
California Univ., Los Angeles. Dept. of Civil Engineering.
For primary bibliographic entry see Field 6A.
W87-02296

OPTIMAL MULTIRESERVOIR NETWORK CONTROL BY THE DISCRETE MAXIMUM PRINCIPLE,
Dorsch Consult G.m.b.H., Munich (Germany, F.R.).

For primary bibliographic entry see Field 6A.
W87-02298

GROUND SURFACE SLOPE AS A BASIN SCALE PARAMETER,
Cornell Univ., Ithaca, NY. School of Civil and Environmental Engineering.
Y. B. Zecharias, and W. Brutsaert.
Water Resources Research WRERAQ, Vol. 21, No. 12, p 1895-1902, December 1985. 5 fig, 3 tab, 30 ref.

Descriptors: *Slopes, *Basins, *Geomorphology, Topography, Soil surveys, Estimating equations, Model studies, Watersheds, Appalachian Plateau, Statistical methods.

A method for determining the typical slope of a basin is proposed which considers basin geometry and geomorphological characterisitics and involves only those quantities that can be easily extracted from topographic maps. Characteristic basin slope values of 19 Appalachian Plateau watersheds were determined using this method. These values were compared with those using Horton's intersection line method and with those derived from county soil survey reports and maps. Comparisons showed close agreement between the three sets of values. Similar comparisons involving values obtained by previous slope methods indicated that they were poorly related to actual average basin slope, and that most were incapable of detecting small differences in slope between similar watersheds. The proposed method significantly reduces the amount of work required by other methods of comparable accuracy. (Michael-PTT)
W87-02305

EMERGENCE OF GLOBAL-SCALE HYDROLOGY,
Massachusetts Inst. of Tech., Cambridge. Dept. of Civil Engineering.
P. S. Eagleson.
Water Resources Research WRERAO, Vol. 22, No. 9, p 6S-14S, August 1986. 8 fig, 39 ref.

Descriptors: *Hydrological regime, *Forecasting, Environmental effects, Hydrology, Atmosphere, Model studies, Measuring instruments, Water cycle.

Emerging problems of environmental change and of long range hydrologic forecasting demand knowledge of the hydrologic cycle at global rather than catchment scale. Changes in atmosphere and/or landscape characteristics modify the earth's metabolism through changes in its biogeochemical cycles. The most basic of these is the water cycle which directly affects the global circulation of both atmosphere and ocean, and hence is instrumental in shaping weather and climate. Defining the spatial extent of the environmental impact of a local land surface change, or identifying, for forecasting purposes, the location and nature of climatic anomalies that may be causally linked to local hydrologic persistencies, requires global scale dynamic modeling of the coupled ocean-atmosphere-land surface. Development, evaluation, verification, and use of these models requires the active participation of hydrologists along with a wide range of other earth scientists. The current state of these models with respect to hydrology, their weaknesses, data needs, and potential utility are discussed. (Author's abstract)
W87-02312

LOOKING FOR HYDROLOGIC LAWS,
University Coll., Galway (Ireland). Dept. of Engineering Hydrology.
J. C. I. Dooge.
Water Resources Research WRERAO, Vol. 22, No. 9, p 46S-58S, August 1986. 5 fig, 3 tab, 92 ref.

Descriptors: *Hydrologic properties, *Hydrological regime, *Research needs, Model studies, Hydrologic models, Floods.

The search for regularities in hydrologic relationships is discussed against the background of the general types of predictive models used in sciences. The various approaches to the study of water are compared and contrasted. Flood hydrology at the present time draws both on a microscale approach based on continuum mechanics and on a macroscale approach based on the statistical study of large aggregates. Neither approach is entirely appropriate to catchment hydrology, which involves systems intermediate in size between the local scale at a major geographical region. Nevertheless, the microscale and macroscale approaches are relevant to the formulation and verification of hydrologic laws at the intermediate mesoscale of the catchment. Those elements of present flood hydrology that are soundly based on deductions from hypotheses confirmed by data either hydrologic or nonhydrologic would contribute in varying degrees to a scientific theory of flood hydrology at the catchment scale. A good deal of work needs to be done to develop such a theory through synthesis and new inspiration. It is appreciated that in the interim, practical hydrologists must continue to use existing techniques to solve problems of economic and social importance. However, the endeavor to produce such a theory would be well worthwhile. (Lantz-PTT)
W87-02315

NOTE ON SIMULATION OF SAMPLES OF GAMMA-AUTOREGRESSIVE VARIABLES,
George Washington Univ., Washington, DC. International Water Resources Inst.
J. T. B. Obeysekera, and V. Yevjevich.
Water Resources Research WRERAO, Vol. 21, No. 10, p 1569-1572, October 1985. 5 fig, 13 ref. NSF Grant CEE-7916817.

Descriptors: *Simulation analysis, *Autoregressive models, *Distribution analysis, *Hydrologic models, Model studies, Statistical analysis, Stochastic hydrology, Mathematical studies.

The generation of samples of stochastic processes of given autocorrelation structure and marginal distribution is a current problem in stochastic hydrology. Past attempts to solve this problem have focussed attention primarily on generating samples of skewed hydrologic variables of the first-order autoregressive model. Another widely suggested procedure uses a skewed distribution. A procedure for the generation of samples of an autoregressive scheme that has an exact gamma marginal distribution with given mean, variance, and skewness is reported. Some characteristics of the commonly used Wilson-Hilferty transformations are discussed. The modified Wilson-Hilferty transformation is shown to have a mixed distribution with a nonnegligible probability mass at its lower bound. For high skewness within the limits of its suggested applicability the probability mass can be large, with the probability density function of the modified Wilson-Hilferty variate significantly deviating from the corresponding gamma distribution it is intented to approximate. (Lantz-PTT)
W87-02387

2B. Precipitation

DETERMINATION OF ACETIC, FORMIC, AND PROPANOIC ACIDS IN RAIN WATER BY REVERSE-PHASE HIGH-PERFORMANCE LIQUID CHROMATOGRAPHY,
Commonwealth Scientific and Industrial Research Organization, Aspendale (Australia). Div. of Atmospheric Research.
For primary bibliographic entry see Field 5B.
W87-01866

COMPARATIVE ANALYSIS OF TECHNIQUES FOR SPATIAL INTERPOLATION OF PRECIPITATION,
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
G. Q. Tabios, III, and J. D. Salas.
Water Resources Bulletin WARBAQ, Vol. 21, No. 3, p 365-380, June 1985. 12 fig, 11 tab, 21 ref. NSF Grant CEE-8110782.

Descriptors: *Probaability distribution, *Interpolation techniques, *Precipitation, *Mathematical studies, *Least squares method, Thiessen polygon, Polynomial interpolation, Inverse distance method, Multiquadric interpolation, Optimal interpolation, Kriging interpolation, West Point, Crete, Hastings, Oscelos.

The applicability of various proposed interpolation techniques for estimating annual precipitation at selected sites is examined. These techniques include the commonly used Thiessen polygon, the classical polynomial interpolation by Lagrange or least-squares method, the inverse distance method, multiquadric interpolation, optimal interpolation, and Kriging interpolation. Thirty years of annual precipitation data at 29 stations located in the Region II of the North Central continental United States are used for the study. The stations include: Albion, Arcadia, Aurora, Beatrice 1, Clay Center, Crete, Ericson 6WNW, Ewing, Fairmont, Franklin, Genoa 2W, Hastings, Kearney Lincoln Agro Farm, Oakdale, Oscelos, Osmond, Ravenna, St. Paul, Schuyler, Stanton, Superior, Upland, Utica, Wahoo, Wakefield, Walthill, Western, and West Point. The comparison is based on the error of estimates obtained at the following five selected sites: Ericson, West Point, Crete, Hastings, and Oscelos. The Kriging and optimal interpolation techniques are superior to the other techniques. However, the multiquadric technique is almost as good as those two. The inverse distance interpolation and the Thiessen polygon gave fairly satisfactory results while the polynomial interpolation did not produce good results. (Peters-PTT)
W87-01909

STORM CHARACTERISTICS OF CONVECTIVE-SCALE PRECIPITATION,
Texas Tech Univ., Lubbock. Atmospheric Science Group.
E. A. Pani, and D. R. Haragan.
Water Resources Bulletin WARBAQ, Vol. 21, No. 3, p 393-405, June 1985. 12 fig, 6 tab, 7 ref.

Descriptors: *Precipitation, *Storms, *Radar, Hydrometeorology, Hydrology, Meteorology, Data classification scheme, Probability distribution, Storm duration, Rainfall volume, Clusters, Remote sensing, Satellites.

A classification scheme for convective precipitation, having applications in both analysis and modeling of meteorological and hydrological events, is presented. The method is based upon observations of rainfall at the ground, radar scans of storm events, and visible and infrared satellite imagery of larger storm systems. A data classification scheme for convective precipitation with characteristics which are distinctly different among the four categories has been established. Empirical cumulative probability distributions for storm duration, rainfall volume, and time between storms were derived for each of the convective categories and showed marked dissimilarities. These distributions are particularly useful for the development of meteorological and hydrological models. The stratification is applicable to the experimental design of weather modification projects. When atmospheric conditions limit storm development to cells, rain was seldom observed. Cells, that produce small amounts of rainfall when they do precipitate, would not appear to be likely candidates for rainfall enhancement attempts unless they could be induced to form clusters and extend their short lifetimes. Small clusters also produce small amounts of rain, but since they are longer lived than cells, may be better candidates for seeding if they could be encouraged to form large clusters. Large and nested clusters usually produce large amounts of natural precipitation. A few of these large storms usually account for most of a season's rainfall. (Peters-PTT)
W87-01911

REGIONAL FREQUENCY ANALYSIS OF HYDROLOGIC MULTIYEAR DROUGHTS,
Kansas State Geological Survey, Lawrence.
J. Sadeghipour, and J. A. Dracup.
Water Resources Bulletin WARBAQ, Vol. 21, No. 3, p 481-487, June 1985. 3 fig, 4 tab, 25 ref. NSF Grant 77-11137; Univ. California Water Resources

Center Grant W-615.

Descriptors: *Drought, *Frequency analysis, *Multivariate analysis, Hydrologic models, California, Sacramento Valley, San Joaquin Valley.

Regional frequency analysis of hydrologic multiyear drought is discussed. A drought event is defined by three parameters: severity, duration, and magnitude. A drought is characterized as any year or consecutive number of years during which average annual streamflow is continuously below the long-term mean annual runoff. A method is proposed to standardize drought severities with a duration adjustment to enable comparison among drought events. The possibility of generating a long series of hydrologic droughts by use of the statistical parameters derived from the short historical sample is investigated. The proposed procedures are applied to historical streamflow records from the Central Valley region of California. The Central Valley is divided into two subdivisions: the Sacramento Valley in the north and the San Joaquin Valley in the south. Seven San Joaquin Valley streams were used in the regional frequency study: Choschilla R., Falls Cr., Merced R., Middle Tuolumne R., San Joaquin R., South Tuolumne R., and Woods Cr.. In applying extreme drought frequency analysis to the San Joaquin Valley streams, a drought with a recurrence interval of 125 years was determined from a historic record of 46 years. The index drought method is utilized to estimate droughts associated with exceedence probabilities from about 10 percent to 90 percent. By combining the results of these two analyses, a single regional drought-frequency curve can be obtained. This study proposes a standardization method to put the drought events with different durations on a comparable basis. The regional drought frequency study demonstrates the necessity of improvements in the present techniques for the frequency analysis of droughts. Extensive research remains to be accomplished in the regional hydrologic analysis of the severity, duration, and frequency of droughts. (Peters-PTT)
W87-01922

SATELLITE PASSIVE 37-GHZ SCATTERING-BASED METHOD FOR MEASURING OCEANIC RAIN RATES,
National Aeronautics and Space Administration, Huntsville, AL. George C. Marshall Space Flight Center.
For primary bibliographic entry see Field 7B.
W87-01960

MULTIPLE REMOTE SENSOR OBSERVATIONS OF SUPERCOOLED LIQUID WATER IN A WINTER STORM AT BEAVER, UTAH,
Utah Univ., Salt Lake City. Dept. of Meteorology.
K. Sassen, R. M. Rauber, and J. B. Snider.
Journal of Climate and Applied Meteorology JCAMEJ, Vol. 25, No. 6, p 825-834, June 1986. 9 fig, 2 tab, 7 ref. NOAA Awards 83-5175, 84-5237, and 83-5187.

Descriptors: *Remote sensing, *Supercooling, *Clouds, *Water, *Storms, *Beaver, Utah, Cloud-seeding, Snow, Storm water, Temporal distribution, Spatial distribution, Precipitation, Weather modification.

Remote sensing observations are used to characterize the temporal and spatial distribution of cloud liquid water in a winter storm from the 1983 Utah/NOAA Cooperative Weather Modification Program. The remote sensors, located at a mountain-base site near Beaver, Utah, consisted of a dual-channel microwave radiometer operated in an azimuthal scanning mode, and a polarization lidar and K sub u-band radar both operated in the vertically pointing mode. The cloud system was associated with the passage of a weak cold front and produced only light snowfall across the barrier network of precipitation gages. Although the amounts of supercooled water detected radiometrically varied considerably during the storm, liquid water depths were consistently enhanced in the direction of the barrier. The spatial distribution of liquid water underwent a transition from a primarily orographic distribution to a more area-wide pattern immediately behind the front, and then became convective as the storm dissipated. A new method of analysis applied to the scanning microwave radiometer measurement appears promising for relating liquid water concentrations with the local topography. The near real-time availability of the measurements may lead to improvements in cloud seeding strategies. (Author's abstract)
W87-01961

WATER VAPOR VERTICAL PROFILE STRUCTURES RETRIEVED FROM SATELLITE DATA VIA CLASSIFICATION AND DISCRIMINATION,
Colorado State Univ., Fort Collins. Dept. of Atmospheric Science.
A. E. Lipton, D. W. Hillger, and T. H. Vonder Haar.
Monthly Weather Review MRWEAB, Vol. 114, No. 6, p 1103-1111, June 1986. 8 fig, 2 tab, 25 ref.

Descriptors: *Water vapor, *Profiles, *Satellite technology, *Classification, *Weather forecasting, Statistical analysis, Mathematical studies, Weather, Regression analysis, Precipitation, Forecasting.

A method is presented for retrieving the basic vertical structure of water vapor profiles from satellite-observed radiances. The statistical tools of empirical orthogonal function analysis and clustering were used to define classes of vertical structure of water vapor. As a result, any water vapor sounding can be assigned to one of four vertical structure classes. Each class was shown to be identified with certain types of weather features. Multiple regression was used to retrieve approximate total precipitable water by use of brightness temperatures simulated for the Defense Meteorological Satellite Program SSH-2 infrared sounder, resulting in explained variances of about 80%. Discriminant analysis was then applied to retrieve the vertical structure class of each water vapor profile, giving percentages of correct discrimination near 60%. Selection from among the SSH-2 spectral channels was used to optimize both the total water regression and the structure class discrimination. It also was shown that separation of soundings by total water content generally improves discrimination skill by a few percent. The results suggest that this retrieval approach should be particularly useful for subjective weather forecasting. (Author's abstract)
W87-02042

RAINFALL SHORTAGE AND EL NINO-SOUTHERN OSCILLATION IN NEW CALEDONIA, SOUTHWESTERN PACIFIC,
Surtropac Group, Noumea (New Caledonia).
A. Morliere, and J. P. Rebert.
Monthly Weather Review MRWEAB, Vol. 114, No. 6, p 1131-1137, June 1986. 6 fig, 4 tab, 10 ref.

Descriptors: *Rainfall, *El Nino, *New Caledonia, *Rainfall distribution, *Seasonal variation, *Weather forecasting, Precipitation, Statistical analysis, Mathematical studies, Forecasting, Drought.

About three months after the beginning of an El Nino/Southern Oscillation (ENSO) year, a rainfall shortage develops over all of New Caledonia and lasts for 12 months. There is, on the average, a 22% decrease over the mean monthly rainfalls for one year. This result is based on the study of a rainfall composite, and of a composite obtained from the first empirical orthogonal function (EOF), extracting more than half of the variance over 30 years of measurement at 18 stations. Poor correlation with the Southern Oscillation index shows that only a small part, if any, of the rainfall variance is predictable through ENSO. Though the one-year shortage is significant, the monthly variability in a drought period is strong, and in order to interpret the shortage in probabilistic terms one would need to adjust the rainfall distribution, or transform this distribution to percentile ranks. However, the phenomenon can be considered as its own predictor, and it is concluded that disasters associated with the drought could be forecasted six months in advance. (Doria-PTT)
W87-02043

INFLUENCE OF THE ATLANTIC, PACIFIC, AND INDIAN OCEANS ON SAHEL RAINFALL,
British Meteorological Office, Bracknell (England).
T. N. Palmer.
Nature NATUAS, Vol. 322, No. 6076, p 251-253, July 17, 1986. 3 fig, 7 ref.

Descriptors: *Atlantic Ocean, *Drought, *Pacific Ocean, *Indian Ocean, *Sah *Rainfall, *Weather, *Climatology, Water temperature, Temperature, Model studies Precipitation rate, Rainfall distribution.

Persistently dry and wet periods of several years in the Sahel have been accompanied by global-scale patterns of sea-surface temperature (SST) anomaly. The response of a general circulation model (GCM) of the atmosphere to an observed composite SST difference field between a number of such dry and wet periods has been reported elsewhere to show substantial reduction in Sahel rainfall compared with values from a simulation with climatological SSTs. The same model's response to the individual components of the composite SST difference field in the Atlantic, Pacific, and Indian Oceans. Over the western Sahel, the Atlantic and Pacific fields have a comparable effect in reducing rainfall, whereas the Indian Ocean field produces a slight enhancement. Results suggest that, over the eastern Sahel, the Indian Ocean has the dominant role in reducing rainfall. (Doria-PTT)
W87-02076

ACIDITY OF SCOTTISH RAINFALL INFLUENCED BY CLIMATIC CHANGE,
University of East Anglia, Norwich (England). Climatic Research Unit.
For primary bibliographic entry see Field 5B.
W87-02078

CONTRASTING RESPONSE TO SIMULATED ACID RAIN OF LEAVES AND COTYLEDONS OF CABBAGE (BRASSICA OLERACEA L.),
Toronto Univ. (Ontario). Dept. of Botany.
For primary bibliographic entry see Field 5C.
W87-02081

CLIMATE PREDICTION IN THE TROPICS,
Wisconsin Univ.-Madison. Dept. of Meteorology.
S. Hastenrath.
Bulletin of the American Meteorological Society, Vol. 67, No. 6, p 696-702, June 1986. 4 fig, 70 ref. NSF Grant ATM84-13575.

Descriptors: *Climatology, *Tropic zone, *Weather forecasting, *Prediction, Climatic data, Climatic zones, Meteorological data collection, Statistical analysis, Statistical methods, Rainfall, Monsoons, India, Indonesia, El Nino, Seasonal variation, Drought, Brazil, Africa, Hurricanes.

Results of published work on climate prediction in several tropical areas are presented and five categories of prediction approaches are suggested. These include: (1) extrapolation of empirically or theoretically deduced periodicities; (2) assessment of statistical relationships between rainfall and various meteorological elements; (3) the relationship betwen preseason rainfall and that at the height of the rainy season; (4) diagnostic studies of climate and circulation anomalies coupled with statistical methods; and, (5) numerical models. The predictive potential of these methods are evaluated in terms of the practical benefits of climate prediction. (Michael-PTT)
W87-02109

URBAN HYDROMETEOROLOGY REVIEW,
Illinois State Water Survey Div., Champaign. Climatology and Meteorology Section.
F. A. Huff.
Bulletin of the American Meteorological Society, Vol. 67, No. 6, p 703-711, June 1986. 9 fig, 1 tab, 23 ref.

Descriptors: *Weather forecasting, *Urban hydrology, *Chicago, *Illinois, *Hydrometeorology, Metropolitan water management, Meteorological data collection, Urban runoff, Storm water, Rainfall intensity, Rainfall-runoff relationships, Rain gages, Monitoring, Thunderstorms, Weather modification, Flood forecasting, Flood frequency, Flood control.

Hydroclimatic factors in the design and operation of urban hydrologist systems are discussed in terms of frequency distribution of storm rainfall, time distribution of rainfall as illustrated by profiles of several Illinois storms, characteristics and effects of intense localized storms, and hydrologic implications of inadvertent weather modification as demonstrated by METROMEX studies of heavy rainstorms and climate-related increases in floods. The Chicago dense raingage network for monitoring storm rainfall in an urban area is described. The importance of more detailed and realistic hydroclimatic models for use in the design and operation of flood control systems is emphasized. (Michael-PTT)
W87-02110

DETERMINATION OF ERODABILITY OF A SUBTROPICAL CLAY SOIL: A LABORATORY RAINFALL SIMULATOR EXPERIMENT,
Institute of Agricultural Engineering, Harare (Zimbabwe).
For primary bibliographic entry see Field 2J.
W87-02119

EFFECT OF SOWING TIME ON GROWTH, YIELD AND WATER-USE OF RAIN-FED WHEAT IN THE WIMMERA, VIC.,
Victoria Dept. of Agriculture, Werribee (Australia). Animal Research Inst.
For primary bibliographic entry see Field 3F.
W87-02142

INFLUENCE OF TRANSITION METAL COMPLEXES ON ATMOSPHERIC DROPLET ACIDITY,
Bell Labs., Murray Hill, NJ.
T. E. Graedel, C. J. Weschler, and M. L. Mandich.
Nature NATUAS, Vol. 317, No. 6034, p 240-242, September 19, 1985. 1 fig, 3 tab, 32 ref.

Descriptors: *Transition metals, *Acid rain, *Metal complexes, *Acidity, *Atmospheric droplets, Metals, Precipitation, Water chemistry.

Transition metals are among the common constituents of cloud droplets, raindrops, and other atmospheric droplets. In order to evaluate the relative importance of pathways catalysed by transition metals in the atmospheric droplet chemistry a detailed model of chemistry, the first of its kind, has been modeled which incorporates transition metal complexes. The computer simulations suggested that at pH 4, transition metal catalysed pathways account for 30-55% of the oxidation of S(IV) to S(VI). The calculations which were made suggested that transition metal reactions are the principal sources of free radicals in atmospheric droplets and that a catalytic cycle involving the Fe(II) - Fe(III) couple was an efficent producer of organic acids from oxidation of the ubiquitous atmospheric aldehydes. (Author's abstract)
W87-02173

REGIONAL ACIDIC CLOUD/FOG WATER EVENT IN THE EASTERN UNITED STATES,
Institute of Ecosystem Studies, Millbrook, NY.
K. C. Weathers, G. E. Likens, F. H. Bormann, J. S. Eaton, and W. B. Bowden.
Nature NATUAS, Vol. 319, No. 6055, p 657-658, February 20, 1986. 1 fig, 1 tab, 18 ref.

Descriptors: *Clouds, *Fog, *Water, *Eastern United States, *Acidic water, *Water pollution sources, *Acid rain, Precipitation, Ecosystems, Sulfates, Nitrates, Pollution.

Cloud and fog water constitutes an important hydrological input to specific ecosystems. There are but a few data on the chemistry of cloud and fog water; those that exist suggest generally low pH values and high concentrations of major inorganic cations, anions and trace metals, when compared with rain water collected from the same or nearby locations. The first analysis of a widespread, episodic cloud/fog event, using samples which were collected during August 1984, at six non-urban sites in the eastern United States, has been presented. The analysis showed that the pH was extremely low (2.8-3.09) and concentrations of sulphate and nitrate were 7-43 times greater than those for average precipitation at four eastern sites, and higher than previously reported values for cloud/fog water in the eastern United States. Such water may add ecologically significant amounts of pollutants and nutrients to many ecosystems in the region. (Author's abstract)
W87-02177

EFFECTS OF SIMULATED ACIDIC RAIN ON ONE SPECIES EACH OF PSEUDOPARMELIA, USNEA, AND UMBILICARIA,
Oak Ridge National Lab., TN. Environmental Sciences Div.
For primary bibliographic entry see Field 5C.
W87-02191

ATMOSPHERIC DEPOSITION TO REMOTE RECEPTORS: I. PRECIPITATION QUANTITIES FRO THE ILWAS-NETWORK,
Rensselaer Polytechnic Inst., Troy, NY. Dept. of Chemical and Environmental Engineering.
A. H. Johannes, and E. R. Altwicker.
Water, Air, and Soil Pollution WAPLAC, Vol. 28, No. 1/2, p 39-53, 1986. 4 4 fig, 5 tab, 17 ref.

Descriptors: *Acid rain, Precipitation gauges, *Precipitation, Watersheds, N Water basin variability, *Precipitation networks, Acidification.

A dense precipitation network was operated for 45 months in three remote watersheds in the Adirondack Park of New York. The network consisted of 4 to 7 wet/dry collectors spaced 3 m to 30 km apart; network operation was on an event basis. The chief objective was an accurate determination of atmospheric inputs into the three watersheds and an assessment of intra- and interbasin variability. Approximately 96% of all possible events were captured. One of the watersheds received from 6 to 36% less precipitation on a seasonal basis. The capture efficiency relationship between volume collected and standard rain gauge was quantified and shown to be a function of precipitation quantity, type and sampler location. (See also W87-02198, W87-02199) (Author's abstract)
W87-02197

ATMOSPHERIC DEPOSITION TO REMOTE RECEPTORS: II. TEMPORAL AND SPATIAL VARIATION OF INORGANIC ION SPECIES IN PRECIPITATION OVER THE ILWAS-NETWORK,
Rensselaer Polytechnic Inst., Troy, NY. Dept. of Chemical and Environmental Engineering.
For primary bibliographic entry see Field 5B.
W87-02198

ATMOSPHERIC DEPOSITION TO REMOTE RECEPTORS: III. STATISTICAL ANALYSIS OF PRECIPITATION DATA FROM THE ILWAS-NETWORK,
Rensselaer Polytechnic Inst., Troy, NY. Dept. of Chemical and Environmental Engineering.
E. R. Altwicker, P. E. Shanaghan, and A. H. Johannes.
Water, Air, and Soil Pollution WAPLAC, Vol. 28, No. 1/2, p 71-88, 1986. 4 fig, 7 tab, 19 ref, 2 append.

Descriptors: *Acid rain, *Atmospheric deposition, *Statistical analysis, *Precipiation, *ILWAS-network, New York, Acidification.

A statistical analysis of the precipitation data base from the Integrated Lake-Watershed Acidification Study (ILWAS) is presented. Included in this analysis are: equivalence of distributional form of the concentrations; ion pair concentration analysis; regression by site and season; precipitation type; and multiple regressions. The analysis emphasized the ions H, NH4, SO4, and NO3. Variability in H was explained through SO4 and NO3; spatial variability for the species pairs SO4-H, NO3-H, and SO4-NH4, and NO3-NH4 does not suggest significant differences among sites on a seasonal basis. (See also W87-02197, W87-02198) (Author's abstract)
W87-02199

SCALE OF FLUCTUATION OF RAINFALL MODELS,
Universidad Simon Bolivar, Caracas (Venezuela). Graduate Program in Hydrology and Water Resources.
I. Rodriguez-Iturbe.
Water Resources Research WRERAO, Vol. 22, No. 9, p 15S-37S, August 1986. 16 fig, 21 ref.

Descriptors: *Rainfall, *Model studies, *Fluctuations, Spatial distribution, Temporal distribution, Rainfall distribution, Rainfall intensity.

The role of scale in the rainfall characterizations resulting from different rainfall models is the main issue under study. Three different types of models are analyzed: temporal rainfall models at a point, areal storm rainfall models, and space-time rainfall representations. The perspective is taken that precipitation models need mainly to incorporate those features of the process which lead to an adequate representation under some amount of local averaging, either in time or in space or in space and time. Thus the characteristics of the averaged rainfall process resulting from the different models are analyzed with a special emphasis on the role of the scale of fluctuation of the process in these characteristics. (Author's abstract)
W87-02313

AREAL REDUCTION FACTORS FROM RAIN MOVEMENT,
Uppsala Univ. (Sweden). Dept. of Hydrology.
L. Bengtsson, and J. Niemczynowicz.
Nordic Hydrology, Vol. 17, No. 2, p 65-82, 1986. 11 fig, 9 tab, 20 ref.

Descriptors: *Rainfall distribution, *Reduction factors, *Areal precipitation, *Sweden, Convective storms, Hyetographs, Rainfall intensity, Rainstorms, Rainfall rate, Rainfall.

The relation between rain movement and areal reduction of rain intensity is investigated, and an approach for calculating areal reduction factors from point hyetographs and storm speed is suggested. Results indicate that convective storms seem to follow a similar pattern over Sweden. Storm speed and parameters that describe the shape of synthetic hyetographs are almost equal for different places. Therefore, areal reduction factors are very much the same for different Scandinavian cities. A relationship exists between areal reduction of point rainfall and storm movement, and from the information about rain intensity at a point and storm speed, areal precipitation, and moving storm derived areal reduction factors (M-ARF) can be determined. If historical storm data is not available, M-ARF can be estimated from synthetic design storms. M-ARF's calculated for Lund agree very well with areal reduction factors determined from observations in a dense net of rain gauges. Since convective storms are of similar character at all places in Sweden, M-ARF calculated by the moving storm approach should represent the true areal reduction for most places in Sweden. (Lantz-PTT)
W87-02327

LOCAL RAINFALL VARIABILITY - A POTENTIAL BIAS FOR BIOECOLOGICAL STUDIES IN THE CENTRAL AMAZON,
Instituto Nacional de Pesquisas da Amazonia, Manaus (Brazil).
M. de N. G. Ribeiro, and J. Adis.
Acta Amazonica, Vol. 14, No. 1/2, p 159-174, March-June 1984. 8 fig, 2 tab, 28 ref.

Group 2B—Precipitation

Descriptors: *Amazon Basin, *Rainfall, *Rainfall intensity, *Statistics, Ecology, Microclimates, Seasonal variation.

Rainfall data registered between 1910 and 1979 at Manaus confirm the existence of a dry season between June and November (monthly rainfall: 42-162 mm) and a rainy season from December until May (monthly rainfall: 211-300 mm). Annual precipitation amounted to 2105 mm with about 75% of the rainfall recorded during the rainy season. Rainfall data collected over 12 months at eight stations in the vicinity of and at Manaus are compared. Annual precipitation was lower in Inundation Regions (1150-2150 mm) compared with Dryland Regions (2400-2550 mm). Considerable differences are found in rainfall patterns (intensity, frequency, and time of rainfall). This is also true for neighboring stations, even if data of an 11-year record period are compared. Thus, it is highly recommended that precipitation data for bioecological studies be collected at the study site. (Author's abstract)
W87-02430

EFFECTS OF ACID PRECIPITATION ON GROUND WATER QUALITY IN THE NORTHEASTERN UNITED STATES,
IEP, Inc., Worthington, OH.
For primary bibliographic entry see Field 5C.
W87-02468

2C. Snow, Ice, and Frost

THEORETICAL AND EXPERIMENTAL INVESTIGATION ON DENSE SNOW AVALANCHE MOTION, (INVESTIGATION THEORIQUE ET EXPERIMENTALE DES CARACTERISTIQUES DYNAMIQUES DES AVALANCHES DE NEIGE DENSE),
G. Brugnot, and J. P. Vila.
La Houille Blanche, Vol. 85, No. 2, p 133-142, 1985. 8 fig, 30 ref.

Descriptors: *Dense snow, *Avalanches, *Navier-Stokes models, *Voellmy models, *Saint-Venant models, Mathematical models, Japan, Canada, Switzerland, Soviet Union, France, Computation, Research programs.

The status of research conducted on dense snow avalanche motion is discussed; experimental work is analyzed from the standpoints of load measurements and kinematic measurements and modelling and computation are discussed. Programs of research in the following nations are described: Japan, Canada, Switzerland, Soviet Union, and France. Models of simplified type (Voellmy), Navier-Stokes unstationary models, and Saint-Venant models are described. (Rochester-PTT)
W87-01969

SIGNIFICANCE OF GROUND FREEZING ON SOIL BULK DENSITY UNDER ZERO TILLAGE,
Guelph Univ. (Ontario). Dept. of Land Resource Science.
For primary bibliographic entry see Field 2G.
W87-02028

MEASUREMENT OF ORGANIC CARBON IN POLAR SNOW SAMPLES,
New Hampshire Univ., Durham. Dept. of Earth Sciences.
For primary bibliographic entry see Field 5A.
W87-02178

SPRING MELTWATER MIXING IN SMALL ARCTIC LAKES,
Manitoba Univ., Winnipeg. Dept. of Zoology.
For primary bibliographic entry see Field 2H.
W87-02253

RADIATION BALANCES OF MELTING SNOW COVERS AT AN OPEN SITE IN THE CENTRAL SIERRA NEVADA, CALIFORNIA,
San Diego State Univ., CA. Dept. of Geography.
E. Aguado.
Water Resources Research WRERAO, Vol. 21, No. 11, p 1649-1654, November 1985. 7 fig, 2 tab, 16 ref.

Descriptors: *Solar radiation, *Snow cover, *Snowmelt, *Sierra Nevada, Snowpack, Snow density, Albedo, Cloud cover, Melting.

Radiation balances of melting snowpacks at an open site in the Sierra Nevada, California were measured for three seasons. The snow covers were examples of below-normal, near-normal and above-normal water equivalents. Two of the snow covers melted under clear skies in late spring and the other melted under cloudier conditions when less extraterrestrial radiation was available. No relationship betwen snow density and albedo was observed. The disposition of solar radiation and albedos and their rates of decline were similar for the three melt seasons, despite dissimilarities in melt conditions. Absorbed solar radiation and a cloudiness index were useful predictors for net radiation, accounting for 71% of the total variance. (Author's abstract)
W87-02277

MELTWATER MOVEMENT IN NATURAL HETEROGENEOUS SNOW COVERS,
National Hydrology Research Inst., Ottawa (Ontario).
P. Marsh, and M. -K. Woo.
Water Resources Research WRERAO, Vol. 21, No. 11, p 1710-1716, November 1985. 7 fig, 33 ref.

Descriptors: *Snowmelt, *Meltwater movement, *Snow cover, *Flow measurement, Flow profiles, Melting, Physical properties, Ice-water interfaces, Sierra Nevada, Canada, Arctic, Hydraulic models, Flow discharge, Mathematical equations, Field tests, Fluctuations.

Flow measurements at the base of Arctic snow covers reveal that flow varies from zero to 240% over small areas of the mean surface meltwater flux. Flow variability is primarily controlled by ice layers in the snow cover and is not caused by vertical flow channels with larger grain sizes. Daily fluctuations in flow variability were not sensitive to changes in snow depth or the number of ice layers, but were inversely related to flow volume, with lower variability during high flow days. A multiple-flow path model was developed to route water down independent flow paths, each of which carried a different portion of the flow. The model was successfully applied to data covering several days from the Canadian Arctic and one day from the Sierra Nevada, and may be generally applicable to snow covers in different environments. (Author's abstract)
W87-02284

CLASSIFICATION OF SEASONAL SNOW COVER CRYSTALS,
Cold Regions Research and Engineering Lab., Hanover, NH.
S. C. Colbeck.
Water Resources Research WRERAO, Vol. 22, No. 9, p 59S-70S, August 1986. 23 fig, 34 ref. Cold Regions Research and Engineering Project 4A161120AT24/SS/004.

Descriptors: *Crystals, *Snow cover, *Snow crystals, *Snow metamorphism, *Classification, Snowmelt, Slush, Particles, Ice.

A new classification system that is based on the current understanding of snow metamorphism is proposed. Many crystals could simply be called grain clusters, melt-freeze particles or slush in a wet snow cover and faceted or rounded in a dry snow cover. Problems arise in a wet snow cover because many particles are neither distinctly melt-freeze particles nor grain clusters in a dry snow cover because ice particles often have both rounded and faceted portions. Furthermore, in a dry snow cover mixed particles can develop for more than one reason. The first level of interpretation requires only a casual observation whereas higher levels of interpretation, may require some knowledge of the history of the crystals. For most practical purposes the use of the first level of classification should be adequate for crystals that developed below the surface, whereas for research purposes the greater detail provided in the second level is often necessary. The terms rounded and faceted are descriptive and easily used, although there is a chance that the equilibrium form is partly faceted at low temperatures. Crystals that first grow into a distinct form on the surface and are later buried also undergo complicated processes that are difficult to describe in simple terms. For example, surface hoar crystals (IVA) are sharply faceted during rapid growth, but tend to round off when buried (IIB3). (Lantz-PTT)
W87-02316

EXTRAPOLATING SNOW MEASUREMENTS ON THE MARMOT CREEK EXPERIMENTAL BASIN,
Northern Forest Research Centre, Edmonton (Alberta).
P. Y. Bernier.
Nordic Hydrology, Vol. 17, No. 2, p 83-92, 1986. 6 fig, 1 tab, 6 ref.

Descriptors: *Snow management, *Snow survey, *Snow depth, *Marmot Creek, *Statistical analysis, *Snow cover, Snow density, Spatial distribution, Snow pillows, Snow.

From 1969 to 1980, each March, snow depth and water equivalents were sampled around 249 pins of a grid covering the forested portion of the Marmot Creek basin. Continuous records from four snow pillows, and monthly data from six snow courses were used to extrapolate the spatially intensive grid data to other winter months. Snow courses were better estimators of grid data than snow pillows. Readings from about 80% of the pins were correlated to the data from one or the other snow pillows, demonstrating the feasibility of obtaining winter-long estimates of snow distribution from a once-a-year intensive sampling effort linkeds to a once-a-month sampling of a few snow courses. Paring of points on the basis of goodness of fit appears to yield good extrapolating relations, with an r to the 2nd power above 0.70. The ability of a snow course to track the year-to-year variations in the March data of individual points of the grid was not related to similarities in elevation or aspects between the course and the pins. (Lantz-PTT)
W87-02328

FRAZIL MEASURED IN THE LABORATORY AND IN THE FIELD,
National Water Research Inst., Burlington (Ontario). Hyrdraulics Research Div.
For primary bibliographic entry see Field 7B.
W87-02330

2D. Evaporation and Transpiration

CORRELATION BETWEEN CRASSULACEAN ACID METABOLISM AND WATER UPTAKE IN SENECIO MEDLEY-WOODII,
Zurich Univ. (Switzerland). Inst. of Plant Biology.
For primary bibliographic entry see Field 2I.
W87-01840

BIOLOGICAL ASSAY METHODS IN HYDROBIOLOGICAL STUDIES,
Gosudarstvennyi Gidrobiologii Inst., Leningard (USSR).
V. N. Nikulina.
Soviet Journal of Ecology SJECAH, Vol. 16, No. 3, p 169-176, May/June 1985. 3 fig, 27 ref. Translated from Ekologiya, No. 3, p 55-63, May-June 1985.

Descriptors: *Hydrobiology, *Assay, *Phytoplankton, Bioassay, Plankton, Aquatic life, Eplimnion.

Advantages and disadvantages are discussed for three types of experiments with biological assays used for production-biological purposes: using a test culture under laboratory conditions, and using

natural phytoplankton in situ. It is observed that an isolate volume of water with a natural plankton composition, given several assumptions, simulates the epilimnic layer of a water mass and makes it possible to solve many established problems. (Author's abstract)
W87-01868

LAKE EVAPORATION STUDIES USING SATELLITE THERMAL INFRARED DATA,
Brigham Young Univ., Provo, UT. Dept. of Civil Engineering.
W. Miller, and A. Rango.
Water Resources Bulletin WARBAQ, Vol. 21, No. 6, p 1029-1036, December 1985. 8 fig, 1 tab, 9 ref.

Descriptors: *Evaporation, *Satellite technology, *Remote sensing, *Water temperature, *Thermal infrared data, Lake surface temperature, Heat Capacity Mapping Mission, Utah Lake, Regression analysis, Correlation analysis.

Thermal infrared radiation data were acquired by the Heat Capacity Mapping Mission (HCMM) satellite over the surface area (385 sq km) of Utah Lake during periodic overpasses in 1978 and 1979. The thermal infrared data were converted to lake surface temperatures which were subsequently used in correlations with lake evaporation. Correlations between HCMM surface temperature and pan-derived evaporations exceeded rho = 0.90 when HCMM night and day/night average temperatures and two-day average evaporation values were tested. Similar regression studies were done using monthly data from a conceptual evaporation model and the evaporation pan versus monthly HCMM temperature data. In this test both the HCMM day and night monthly temperature versus the monthly model or pan evaporation had correlations exceeded rho = 0.95. Empirical estimates of both short and long term lake evaporation using satellite thermal infrared data seem feasible. Attempts to use the HCMM thermal information as direct input to a theoretical approach to calculating evaportion were inconclusive; however, a definite potential seems to exist. (Author's abstract)
W87-01938

SOIL HEAT FLUX, THERMAL CONDUCTIVITY, AND THE NULL-ALIGNMENT METHOD,
Commonwealth Scientific and Industrial Research Organization, Canberra (Australia). Div. of Environmental Mechanics.
For primary bibliographic entry see Field 2G.
W87-01982

MODEL EVALUATIONS OF THE IMPACT OF PERTURBED WEATHER CONDITIONS ON SOIL-RELATED CHARACTERISTICS,
Hebrew Univ. of Jerusalem (Israel). Seagram Centre for Soil and Water Sciences.
For primary bibliographic entry see Field 2G.
W87-02019

ATMOSPHERIC CO2 ENRICHMENT OF WATER HYACINTHS: EFFECTS ON TRANSPIRATION AND WATER USE EFFICIENCY,
Agricultural Research Service, Phoenix, AZ. Water Conservation Lab.
For primary bibliographic entry see Field 2I.
W87-02294

CATCHMENT-SCALE EVAPORATION AND THE ATMOSPHERIC BOUNDARY LAYER,
Cornell Univ., Ithaca, NY. School of Civil and Environmental Engineering.
W. Brutsaert.
Water Resources Research WRERAO, Vol. 22, No. 9, p 39S-45S, August 1986. 51 ref. NSF Grant ATM8115713.

Descriptors: *Evaporation, *Atmospheric boundary layer, *Hydrologic scale, Forecasting, Hydrologic budget, Floods, Droughts, Model studies, Watershed, Hydrologic studies, Transport.

Evaporation is an important component of the hydrological cycle; for example, over land surfaces it amounts on average to about 60% of precipitation. This means that for hydrological purposes such as water budget calculations, the prediction or forecasting of floods and droughts, and for dynamic weather forecasting and climate modeling, it is indispensable to have reliable information on land surface evaporation. In mapping a strategy for this, decisions must be made regarding the scales at which this phenomenon is best parameterized. The problem of its determination involves not just sampling, but also its measurement or its calculation. Available methods of parameterization are still inadequate for many practical purposes. Improved parameterization methods at the regional and watershed scale will require a more thorough understanding of the turbulent transport mechanisms in the atmospheric boundary layer. The ABL is of interest at this scale, because of the integrating power of the atmosphere. The structure of the ABL at a given location reflects the overall effect of upwind surface conditions over fetches of the order of tens of kilometers. Therefore a more thorough understanding of turbulent transport mechanisms in the atmospheric boundary layer should lead to improved parameterization methods of evaporation at the regional and watershed scale. (Lantz-PTT)
W87-02314

2E. Streamflow and Runoff

EFFECTS OF SUCCESSIVE FLOW PERTURBATIONS ON STREAM INVERTEBRATES,
Otago Univ., Dunedin (New Zealand). Dept. of Zoology.
For primary bibliographic entry see Field 2H.
W87-01812

INFLUENCE OF SNOWCOVER DEVELOPMENT AND GROUND FREEZING ON CATION LOSS FROM A WETLAND WATERSHED DURING SPRING RUNOFF,
Trent Univ., Peterborough (Ontario). Watershed Ecosystems Program.
For primary bibliographic entry see Field 5B.
W87-01815

SIMULATION OF TURBULENT DISPERSION USING A SIMPLE RANDOM MODEL OF THE FLOW FIELD,
Heriot-Watt Univ., Edinburgh (Scotland). Dept. of Offshore Engineering.
For primary bibliographic entry see Field 5B.
W87-01832

MAPPING PALEOCHANNELS IN FLUVIAL DEPOSITS THROUGH THE APPLICATION OF GEOTECHNICAL STRATIGRAPHY,
A. B. Brillinger.
Bulletin of the Association of Engineering Geologists, Vo. 23, No. 1, p 5-9, February 1986. 2 fig, 6 ref.

Descriptors: *Engineering geology, *Geohydrology, *Fluvial deposits, *Dallas, *Texas, *Trinity River, *Channel flow, Gasoline, Paleohydrology, Stratigraphy.

Flows of water, as well as hazardous fluids, may be encountered in excavations in fluvial deposits. Downtown Dallas, Texas is built on Holocene fluvial deposits of the Trinity River, where significant flows of water and gasoline from the fluvial sands and gravels have occurred in excavations. To predict subsurface flow paths for water and hazardous fluids, paleochannel locations and dimensions must be determined. The organization and analysis of over 1,000 geotechnical logs from the downtown area made it possible to map the paleochannels and associated fluvial deposits. Fluvial environments encountered by these borings were interpreted based on the concept of geotechnical stratigraphy. An empircal stream formula, used to calculate the radius of curvature for meander bends, was used to help predict the presence of a large meander loop which extended outside of the downtown area. (Author's abstract)
W87-01841

ORIENTATION OF CLAMSHELLS AS A VELOCITY INDICATOR IN A CANAL,
Water and Power Resources Service, Sacramento, CA. Mid-Pacific Region.
N. P. Prokopovich.
Bulletin of the Association of Engineering Geologists, Vol. 23, No. 1, p 61-76, February 1986. 14 fig, 2 tab, 15 ref.

Descriptors: *Flow velocity, *Clams, *Canals, *Delta-Mendota Canal, Currents, Sediments, California, Channel flow, Corbicula fluminea.

Orientation of isolated shells of Corbicula fluminea on the surface of clam-bearing sediments in the Delta-Mendota Canal, California, indicates that water velocities within the 'boundary zone' at the surface of the sediments are lower on the inside radius of canal bends as compared with water velocities on the outside radius of the bends or on tangents. In both cases, however, velocities are strong enough to overturn a notable percentage of half shells on a soft substrate into a 'stable' (concave downward) position. Hence, the study indicates the existance of the near-bottom currents capable of moving particles as large as clam shells. Most of canal bottom sediments are composed of much smaller particles. Deposition of such sediments is therfore not a simple mechanical process, but involves filter feeding of Corbicula. (Author's abstract)
W87-01842

APPLICATION OF A LOW-FLOW ASSESSMENT MODEL FOR THE MONONGAHELA RIVER BASIN,
CH2M Hill International Corp., Gainesville, FL.
For primary bibliographic entry see Field 6A.
W87-01895

THRESHOLD TIME SERIES MODELING OF TWO ICELANDIC RIVERFLOW SYSTEMS,
Chinese Univ. of Hong Kong, Shatin. Dept. of Statistics.
For primary bibliographic entry see Field 2A.
W87-01904

OPTIMAL IDENTIFICATION OF MUSKINGUM ROUTING COEFFICIENTS,
North Carolina Univ. at Charlotte. Dept. of Civil Engineering.
For primary bibliographic entry see Field 7C.
W87-01913

CORRELATION OF ANNUAL PEAK FLOWS FOR PENNSYLVANIA STREAMS,
Pennsylvania State Univ., University Park. Dept. of Civil Engineering.
D. J. Wall, and M. E. Englot.
Water Resources Bulletin WARBAQ, Vol. 21, No. 3, p 459-464, June 1985. 2 fig, 2 tab, 11 ref.

Descriptors: *Floods, *Peak discharge, *Peak flow, *Correlation analysis, *Flood peak, *Flood frequency, Pennsylvania, Statistical methods, Streams.

A common assumption in flood frequency analysis is that annual peak flows are independent events. The validity of this assumption with regard to Pennsylvania streams was investigated by statistically analyzing the dependence between annual peak flows and determining if basin carryover effects relate to the degree of dependence. Five tests of dependence, the autocorrelation test, the median crossing test, the turning points test, the rank difference test, and the Spearman rank order serial correlation coefficient test were applied to the series of annual peak flows for 57 streams. Of the 57 streams analyzed, only two exhibited signs of dependence by at least two of the tests performed, and the baseflow component of annual peak flows was unrelated to the degree of dependence exhibited between annual peak flows. It was concluded that the assumption of independence of annual peak flows is valid in flood frequency analysis for Pennsylvania streams. (Author's abstract)
W87-01918

TECHNIQUE FOR MEASURING SCOUR AND FILL OF SALMON SPAWNING RIFFLES IN HEADWATER STREAMS,
Weyerhaeuser Co., Tacoma, WA. Environmental Forestry Research.
For primary bibliographic entry see Field 2J.
W87-01925

USING LANDSAT DATA TO CLASSIFY LAND USE FOR ASSESSING THE BASINWIDE RUNOFF INDEX,
Florida Univ., Gainesville. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 4A.
W87-01928

DERIVATION OF THE GAMMA DISTRIBUTION BY USING THE PRINCIPLE OF MAXIMUM ENTROPY (POME),
Louisiana Water Resources Research Inst., Baton Rouge.
For primary bibliographic entry see Field 2A.
W87-01929

JUSTIFICATION FOR A REDUCTION IN THE CREST-STAGE GAGE PROGRAM IN LOUISIANA,
Geological Survey, Lakewood, CO. Water Resources Div.
For primary bibliographic entry see Field 7A.
W87-01930

APPLICATION OF MATHEMATICAL PROGRAMMING IN PLANNING SURFACE WATER STORAGE,
Arizona Univ., Tucson. Dept. of Hydrology and Water Resources.
N. Buras.
Water Resources Bulletin WARBAQ, Vol. 21, No. 6, p 1013-1020, December 1985. 7 fig, 11 tab, 10 ref.

Descriptors: *Reservoirs, *River basins, *Dynamic programming, *Surface storage, Narmada, India, Reservoir yields, Navagam, Surface reservoir, Hydrologic regime, Streamflows.

One of the major river basins on the Indian subcontinent, still largely undeveloped and which recently attracted some attention, is the Narmada. This river basin, with an estimated mean annual flow of 28 million acre-feet (Maf), over 34 billion cu m (Bcm), at a reliability of 0.75, has more than 30 potential reservoir sites on the main stem and tributaries. The last downstream reservoir site is Navagam. Designing a surface reservoir involves the concept of reservoir yield. This concept embodies three basic information items: hydrologic regime, active storage volume, and reservoir release policy. The magnitude of the active storage was prescribed by a legal procedure, so the planning issue became that of determining the reservoir field given the hydrological information. A stochastic dynamic programming model was formulated to derive a schedule of seasonal optimal reservoir releases and their respective probabilities of occurrence. This schedule is the reservoir yield. The yearly cycle was divided into three seasons representing the actual climatic conditions, and conditional probabilities linking streamflows in consecutive seasons were estimated. An operating policy was postulated, based on the same set of legal decisions that prescribed the active storage volume, and target reservoir releases were assumed. Similarly, target storages at the end of each season were set up. The optimizing/minimizing criterion in the dynamic programming formulation was the sum of squares deviations of actual releases and final storage volumes from their respective targets. (Peters-PTT)
W87-01936

SEASONAL DISTRIBUTION OF FACULTATIVELY ENTEROPATHOGENIC VIBRIOS (VIBRIO CHOLERAE, VIBRIO MIMICUS, VIBRIO PARAHAEMOLYTICUS) IN THE FRESHWATER OF THE ELBE RIVER AT HAMBURG,
Hygienisches Inst. (Germany, F.R.).
For primary bibliographic entry see Field 2H.
W87-01957

RIVER DYNAMICS AND THE DIVERSITY OF AMAZON LOWLAND FOREST,
Turku Univ. (Finland). Dept. of Biology.
J. Salo, R. Kalliola, I. Hakkinen, Y. Makinen, and P. Niemela.
Nature NATUAS, Vol. 322, No. 6076, p 254-258, July 17, 1986. 3 fig, 1 tab, 43 ref.

Descriptors: *Rivers, *Hydrodynamics, *Dynamics, *Amazon forest, *Species diversity, *Forests, Rain forests, Erosion, Satellite technology, Succession, Deposition, Sedimentation, Forest soils, Geomorphology.

The degree of forest disturbance caused by river-channel erosion was studied in 500,000 sq km of the Peruvian Amazon by using analyses of Lansant multi-spectral scanner images. Results indicate that in the upper Amazon region, primary succession on newly deposited riverine soils is a major mode of forest regeneration. Landsat imagery analyses show that 26.6% of the modern lowland forest has characteristics of recent erosional and depositional activity; 12.0% of the Peruvian lowland forest is in successional stages along rivers. This successional development is used to classify the western Amazon rainforests according to their geomorphological erosion-deposition pattern. It is proposed that by causing high site turnover, disturbance, and variation in forest structure the river dynamics may be a major factor in creating and maintaining the high between-habitat (beta-type) species diversity characterizing the upper Amazon. (Doria-PTT)
W87-02077

PHYSIOLOGICAL RESPONSES OF A NATIVE AND AN INTRODUCED DESERT FISH TO ENVIRONMENTAL STRESORS,
California Univ., Davis. Dept. of Wildlife and Fisheries Biology.
D. T. Castleberry, and J. J. Cech, Jr.
Ecology ECOLAR, Vol. 67, No. 4, p 912-918, August 1986. 1 fig, 2 tab, 41 ref.

Descriptors: *Fish physiology, *Fish establishment, *Deserts, *Stresors, *Rivers, *Adaptation, Chubs, Fish populations, Species diversity, Metabolism, Temperature effects, Oxygen depletion, Stream fisheries, Fluctuations, Aquatic habitats.

The physiological responses to abiotic stresses typical of desert rivers of two similar cyprinids (Mojave tui chub and arroyo chub) were compared. These species were selected because the introduced arroyo chub has displaced the native Mojave tui chub from its desert river habitat. The introduced species, when compared to the native, exhibited more appropriate resting-routine metabolic rate responses to increased temperature and decreased oxygen tension and showed better swimming performance responses to high water velocity conditions that are typical of the river habitat. This result was expected because the arroyo chub has a longer evolutionary history in fluctuating stream habitats. It is concluded that differences in adaptation contributed to the replacement of Mojave tui chub by the arroyo chub. (Author's abstract)
W87-02103

CHARACTERISTICS OF HIGH-ENERGY MEANDERING RIVERS: THE CANTERBURY PLAINS, NEW ZEALAND,
McGill Univ., Montreal (Quebec). Dept. of Geography.
M. A. Carson.
Geological Society of America Bulletin BUGMA, Vol. 97, No. 7, p 886-895, July 1986. 11 fig, 2 tab, 29 ref.

Descriptors: *Meanders, *Alluvial channels, *Sediment transport, *New Zealand, *Channel flow, *Channel morphology, Gravel channel accretion, Flow characteristics, Flow pattern, Channel scour, Avulsion, Flumes.

Four natural, gravel-bedded meandering rivers in New Zealand were studied in relation to individual bends and relatively long reaches. Bends that are overwidened relative to channel traverses are distinguished from bends found in constant-width channels. Imbrication directions on bars in the former show no evidence of bed flow aligned toward the inner bank. Bar level accretion is due to general flow divergence. Imbrication patterns of constant width channels in the main part of the bends indicate a bed flow toward the outer bank that causes intense flow convergence and scour along that zone. Localized scour along the outer bank produces a downstream gravel bar that diverts flow against the upvalley bank. This results in premature inflection and a tendency for upvalley channel migration. Avulsion may arrest this migration and aid in keeping sinuosity relatively low. The similarity in behavior between these rivers at the reach level and late-stage pseudomeandering observed in flumes is also discussed. (Michael-PTT)
W87-02129

GRAVITY CURRENTS IN ROTATING SYSTEMS,
Australian National Univ., Canberra. Research School of Earth Sciences.
R. W. Griffiths.
Annual Review of Fluid Mechanics ARVFA3, Vol. 18, p 59-89, 1986. 9 fig, 40 ref.

Descriptors: *Water currents, *Gravity studies, *Hydrodynamics, *Rotational flow, *Gravity flow, Gravity waves, Buoyancy, Steady flow, Flow characteristics, Flow profiles, Boundary conditions, Waves, Eddies, Mathematical equations, Mathematical models.

The structure and dynamics of gravity currents in rotating systems are presented. The formation of gravity currents from localized sources of buoyancy is described. The structure of steady currents that vary only slowly in the streamwise direction and simple models of free-surface currents, flow on a inclined bottom and the effects of topography on bottom currents are reviewed. The generation of inertial boundary currents in response to broad geostrophic flow that normally occurs in coastal areas is discussed. Results of theoretical and experimental studies of density fronts and boundary currents as well as laboratory and oceanic observations of large-amplitude waves and eddies are presented. Theoretical investigations of the effect of finite-amplitude waves on boundary gravity currents are used as background to describe the leading edge of a gravity current in terms of a bore or shock wave. Experimental studies of intruding bores and the application of Bernoulli's equation to predict nose speed and width are also examined. (Michael-PTT)
W87-02224

THREE-DIMENSIONAL AND UNSTEADY BOUNDARY-LAYER COMPUTATIONS,
Office National d'Etudes et de Recherches Aerospatiales, Toulouse (France).
For primary bibliographic entry see Field 8B.
W87-02226

CRITICAL LAYERS IN SHEAR FLOWS,
McGill Univ., Montreal (Quebec). Dept. of Mathematics.
For primary bibliographic entry see Field 8B.
W87-02227

APPROACH TO PARAMETER ESTIMATION AND STOCHASTIC CONTROL IN WATER RESOURCES WITH AN APPLICATION TO RESERVOIR OPERATION,
California Univ., Davis. Dept. of Land, Air and Water Resources.
H. A. Loaiciga, and M. A. Marino.
Water Resources Research WRERAQ, Vol. 21, No. 11, p 1575-1584, November 1985. 6 fig, 2 tab, 33 ref, append. Grant UCAL-WRC-W-634.

Descriptors: *Estimating equations, *Stochastic process, *Parametric hydrology, *Reservoir operation, *California, Model studies, Probabilistic process, Reservoir releases, Flood routing, Flood control, Storage.

An algorithm for estimating parameters in which state-space models represent hydrologic processes in which state variables are observed with error is based on maximizing conditional expectation of the likelihood function of the state equation. The estimation algorithm is numerically stable and guarantees local convergence under mild conditions. This estimation algorithm can be coupled with an opitmal control method to yield a combined control estimation technique that can be easily implemented. Application of the theory and methods is given for flood routing via reservoir operation in a three-reservoir system of the California Central Valley Project. (Michael-PTT)
W87-02269

NONPARAMETRIC KERNEL ESTIMATION OF FLOOD FREQUENCIES,
Ottawa Univ. (Ontario). Dept. of Civil Engineering.
K. Adamowski.
Water Resources Research WRERAO, Vol. 21, No. 11, p 1585-1590, November 1985. 3 fig, 5 tab, 12 ref.

Descriptors: *Parametric hydrology, *Estimating equations, *Flood frequency, *Statistical analysis, *Statistical methods, Statistical models, Probabilistic process, Design floods, Probability distribution.

In a currently used approach to flood frequency analysis based on parametric statistical inference, the assumption is made that the distribution function that describes flood data is known as in a log-Pearson type III distribution. Such an assumption is not always justified and could result in variability in estimating design floods. A new method is developed based on a nonparametric procedure for estimating the probability distribution function. Results indicate that design floods computed from the different assumed distribution and the nonparametric method provide comparable results. This nonparametric method is a viable alternative, does not require a distributional assumption and has the ability of estimating multimodal distributions. (Author's abstract)
W87-02270

SHENANDOAH WATERSHED STUDY: CALIBRATION OF A TOPOGRAPHY-BASED, VARIABLE CONTRIBUTING AREA HYDROLOGICAL MODEL TO A SMALL FORESTED CATCHMENT,
Virginia Univ., Charlottesville. Dept. of Environmental Sciences.
For primary bibliographic entry see Field 6A.
W87-02300

TESTING FLOOD FREQUENCY ESTIMATION METHODS USING A REGIONAL FLOOD GENERATION MODEL,
Washington Univ., Seattle. Dept. of Civil Engineering.
D. P. Lettenmaier, and K. W. Potter.
Water Resources Research WRERAQ, Vol. 21, No. 12, p 1903-1914, December 1985. 3 fig, 6 tab, 12 ref.

Descriptors: *Estimating equations, *Flood frequency, *Hydrologic models, Flood forecasting, Drainage area, Parametric hydrology, Probabilistic process, Regional floods, Regional analysis.

A regional flood generation model is proposed in which the logarithms of the first two moments of annual flood distribution at a site depend on the logarithm of the drainage area. The model is parameterized in terms of the regional mean coefficient of variation and the site-to-site coefficient of variation of the coefficient of variation. Eight flood frequency estimation methods, including two at-site and six regional methods were evaluated. Generated floods were drawn from extreme value 1, lognormal and Pearson 3 parent distributions. The regional estimators had lower root mean square errors than the at-site methods, even when the region was moderately heterogeneous, except when the parent was extreme value 1. The flood index method based on regional probability weighted moments performed well when the regional mean coefficient and coefficient of variation were both low. As these parameters increased, performance degraded due to dominance of the quantile estimation variance by the variance in the at-site estimator. Results suggest that improvements in regional flood estimation will come from improved estimators of the at-site mean annual flood rather than the regional flood frequency distribution. (Author's abstract)
W87-02306

MODELING ALLUVIAL CHANNELS,
D. R. Dawdy, and V. A. Vanoni.
Water Resources Research WRERAO, Vol. 22, No. 9, p 71S-81S, August 1986. 2 fig, 3 tab, 69 ref.

Descriptors: *Alluvial channels, *Channel erosion, *Model studies, Sediment transport, Mathematical models, Bank erosion, Scour, Channel improvement.

The present state-of-the-art for modeling the flow of water, and the transport of sediment in alluvial channels is assessed. The characteristics of several presently available models are described, along with their similarities and differences. To improve the performance of such models, several processes must be better modeled. First, sediment transport functions must be better understood, and better criteria must be presented by the modelers for their selection. Sediment transport functions must be calibrated to field data, preferably field data at the site to be modeled. Second, the bed armoring process must be better understood, and the theoretical approaches used should be verified, if possible. The various empirical algorithms used to simulate the interchange of sediments between the bed and the flow should be compared and, if possible, calibrated. Third, the modification of the cross section as a result of net scour and fill should be better understood, and a physical basis presented for any modification algorithm. Bank erosion is an important problem, and it should be included in models for event modeling as well as those for long-term response, such as for meander migration. Stability problems should be discussed and presented in a more general framework. Finally, the boundary conditions (stage downstream, sediment input upstream) have a strong influence on model results. Their determination is an important part of every model application, although they are not a part of the model. Criteria for choice of boundary conditions should be given more emphasis by the modelers in the descriptions of their models. (Lantz-PTT)
W87-02317

FLOOD ESTIMATES: HOW GOOD ARE THEY,
Linsley, Kraeger Associates Ltd., Santa Cruz, CA.
R. K. Linsley.
Water Resources Research WRERAO, Vol. 22, No. 9, p 159S-164S, August 1986. 1 tab, 15 ref.

Descriptors: *Flood frequency, *Flood peak, *Flood forecasting, Research needs, Hydrologic properties, Hydrologic data, Prediction.

The few tests available suggest that procedures and assumptions in common use for estimating flood peak frequency for ungaged streams are subject to large errors and are biased toward overestimates. Economic analysis of costs and benefits is ignored by many agencies in favor of designing to an arbitrarily selected probability level, commonly 1%. In view of the large expenditures for storm drainage and flood damage mitigation, one may question the wisdom of this approach. Some steps that would help correct the situation are: (1) Professional and scientific societies should encourage the effective testing of hydrologic methods. This should include the requirement that papers which propose new techniques must include the results of tests against observed data in sufficient number to be indicative of the overall accuracy of the method; (2) Professional and scientific societies should take a stand in favor of accuracy and the abandonment of obsolete and unreliable hydrologic methods. They should be as much concerned with application as research; (3) Some organization or coalition of organizations and agencies should undertake formal tests of methods which are in common use, following a pattern similar to that proposed by the Hydrology Subcommittee of the Water Resources Council; (4) Research funding sources should encourage and support testing of hydrologic methods by individual scientists or teams of scientists; (5) Research funding sources should encourage and support research on methods for estimating frequency of flooding as a priority topic; (6) Professional and scientific societies should support a program of specialty certification or registration in hydrology to assure that those practicing in the field are at least minimally competent; (6) Public agencies at all levels of government should adapt their procedures to those proven to be reliable in comparative tests; and (8) University instruction in hydrology should include actual application of methods to flood estimates under simulated field conditions, as a means of educating students to the limitations of hydrologic procedures. (Lantz-PTT)
W87-02324

BRIDGING THE GAP BETWEEN FLOOD RESEARCH AND DESIGN PRACTICE,
New South Wales Univ., Kensington (Australia). School of Civil Engineering.
For primary bibliographic entry see Field 7A.
W87-02325

STRUCTURE AND DYNAMICS OF THE FRENCH UPPER RHONE ECOSYSTEMS: 27. POPULATIONS DYNAMICS OF GAMMARIDS (STRUCTURE ET FONCTIONNEMENT DES ECOSYSTEMES DU HAUT-RHONE FRANCAIS: 27. DYNAMIQUE DES POPULATIONS DE GAMMARES),
Lyon-1 Univ., Villeurbanne (France). Dept. de Biologie Animale et Ecologie.
For primary bibliographic entry see Field 2H.
W87-02337

MICROBIAL INVESTIGATIONS IN RIVERS: V. TAXONOMICAL ANALYSIS OF BACTERIA POPULATIONS FROM THE RIVERS ELBE AND TRAVE AT DIFFERENT SEASONS (MIKROBIOLOGISCHE UNTERSUCHUNGEN IN FLUSSEN: V. TAXONOMISCHE ANALYSE VON BAKTERIENPOPULATIONEN AUS ELBE AND TRAVE ZU VERSCHIEDENEN JAHRESZEITEN),
Kiel Univ. (Germany, F.R.). Inst. fuer Polarokologie.
For primary bibliographic entry see Field 2H.
W87-02343

LOCALIZED CATASTROPHIC DISRUPTION OF THE GASCONADE RIVER FLOOD PLAIN DURING THE DECEMBER 1982 FLOOD, SOUTHEAST MISSOURI,
Southern Illinois Univ. at Carbondale. Dept. of Geology.
D. F. Ritter, and D. S. Blakley.
Geology GLGYB, Vol. 14, No. 6, p 472-476, June 1986. 5 fig, 2 tab, 23 ref.

Descriptors: *Flood damage, *Gasconade River, *Missouri, *Flood plains, Sand, Gravel, Flood rating, Flood plain management, Erosion, Bridges, Drainage ditches.

The December 1982 floods in southeast Missouri were the largest on record for many rivers. Overbank sand and gravel were deposited on many flood-plain sites, and scouring of flood-plain surfaces was common. The flood plain of the Gasconade River near Mt. Sterling, Missouri, underwent significantly greater erosional and depositional alteration than any other locality in the region. Here, sand and gravel derived from the Gasconade channel were deposited on the flood-plain surface as a lobate ridge 30-100 m wide, 1-2 m high, and about 1 km long. A large scour hole occupying an area of

5 ha was vertically eroded into the flood plain to a maximum depth of more than 7 m. These processes destroyed prime farmland and threatened bridge safety. The magnitude of erosion and deposition at Mt. Sterling was probably increased by several factors. First, removal of tree stands that lined the edge of the flood plain prior to construction of the new bridge eliminated a buffer zone that previously dissipated flow energy by turbulence, retarded flow velocity across the flood-plain surface, and promoted deposition in the near-channel zone of the flood plain. Second, placing the bridge on piers and excavating drainage ditches beneath and near the bridge created conditions needed for flow separation, macroturbulence, and vortex-related erosion. Finally, it should be noted that the construction at Mt. Sterling represents a change in the internal character of the flood-plain system. Therefore, geomorphic responses here reflect crossing of intrinsic thresholds. These are different from the more common human effects that result from externally generated changes in the discharge and/or load of a river. (Lantz-PTT)
W87-02368

COMPUTATION OF STEADY-STATE, GRADUALLY VARIED FLOWS IN PARALLEL CHANNELS,
Washington State Univ., Pullman. Dept. of Civil and Environmental Engineering.
M. H. Chaudhry, and A. M. Schulte.
Canadian Journal of Civil Engineering CJCEB8, Vol. 13, No. 1, p 39-45, February 1986. 5 fig, 1 tab, 11 ref, 2 append.

Descriptors: *Steady-state flow, *Parallel channels, *Surface flow, *Mathematical equations, *Channel flow, Flow profiles, Mathematical studies, Algorithms, Computers, Open channels.

To compute the water-surface profiles in steady-state, gradually varied flows in open channels, an algorithm is presented that allows calculation of the flow depths and discharges at all sections of a parallel-channels system simultaneously instead of by the presently used trial-and-error computations. This algorithm is accurate, efficient, and suitable for computer solution. As compared to other methods, it may be used directly for computing flows in parallel channels without necessitating graphical plots or other trial-and-error manual computations. A procedure is outlined so that the resulting matrix for a parallel-channels system may be banded in order to increase accuracy and to reduce computer time and storage. A parallel-channels system is solved for illustration purposes and the results are compared with those obtained by the fourth-order Runge-Kutta method. (Author's abstract)
W87-02375

DOWNSTREAM DILUTION OF A LAHAR: TRANSITION FROM DEBRIS FLOW TO HYPERCONCENTRATED STREAMFLOW,
Cascades Volcano Observatory, Vancouver, WA.
For primary bibliographic entry see Field 2J.
W87-02381

COMPARISON OF ESTIMATED PROBABLE MAXIMUM FLOOD PEAKS WITH HISTORIC FLOODS,
Bureau of Reclamation, Denver, CO. Engineering and Research Center.
K. I. Bullard.
Available from the National Technical Information Service, Springfield, VA. 22161 as PB86 212511, A09 in paper copy, A01 in microfiche. 165 p, 50 tab, 62 plates, 76 ref, append.

Descriptors: *Flood peak, *Historic floods, *Flood forecasting, Flood profiles, Santa Ana River, Riverside, California, Little Red River, Shirley, Arkansas, Little Nemaha River, Syracuse, Nebraska.

This study compares estimated probable maximum flood (PMF) peaks with peak floodflows recorded from selected extreme rainfloods in the 48 conterminous states. Records of peak floodflows from thousands of sites were available for the data collection phase of the study. Initial data collection efforts produced a list of approximately 600 of the extreme and more recent events not covered in previous studies of extreme United States flood peaks. Of these events, 61 were compared with estimated PMF peaks computed using current data and methodology. All of the floods selected for comparison had some field measurements of the flood event and supporting hydraulic computations to produce the recorded peak flow. The earliest event studied was the January 1862 flood on the Santa Ana River near Riverside, California. This flood had a peak flow estimated to be 317,000 cu ft/s. PMF calculations for this study produced a peak of 441,200 cu ft/s for a drainage area of 720 sq mi. The historic event represented 72% of the PMF peak. The most recent event studied was for the Middle Ford of the Little Red River near Shirley, Arkansas. On December 3, 1982, a flood peak of 241,000 cu ft/s was measured for the 302 sq mi basin. This flood more than doubled the previous high recorded flood (from nearly 50 years of records). The PMF peak for this site was estimated top be 318,400 cu ft/s, making the 1982 event 76% of the PMF. One of the largest percentages of the PMF in this study was for the Little Nemaha River near Syracuse, Nebraska. The peak flow at this site occurred on May 9, 1950. It was recorded as 225,000 cu ft/s for a drainage area of 218 sq mi. This was over 1,000 cu ft/s/sq mi for a basin of over 200 sq mi. The PMF peak estimated for this site was 277,000 cu ft/s. Therefore, the 1950 peak represents 81% of the PMF. (Lantz-PTT)
W87-02544

2F. Groundwater

EXCESS UNSUPPORTED 210PB IN LAKE SEDIMENT FROM ROCKY MOUNTAIN LAKES: A GROUNDWATER EFFECT,
Maine Univ. at Orono. Dept. of Geological Sciences.
For primary bibliographic entry see Field 2H.
W87-01796

ISOLATION, IDENTIFICATION, AND GROWTH OF WELL-WATER BACTERIA,
Arizona Univ., Tucson. Dept. of Microbiology and Immunology.
For primary bibliographic entry see Field 5A.
W87-01869

APPLICATION OF CONTINUOUS SEISMIC REFLECTION METHODS TO HYDROLOGIC STUDIES,
Geological Survey, Hartford, CT. Water Resources Div.
F. P. Haeni.
Ground Water GRWAAP, Vol. 24, No. 1, p 23-31, January-February 1986. 8 fig, 20 ref.

Descriptors: *Geophysics, *Seismic reflection studies, *Seismic properties, *Lakes, *Rivers, *Geologic information, *Aquifers, *Hydrologic boundaries, Housatonic River, Connecticut, Massachusetts, Connecticut River, Florida, Sarasota, Port Charlotte.

Oil and gas exploration and engineering studies in water-covered areas routinely use continuous seismic profiling techniques to obtain subsurface geologic information. Such profiling also can be used effectively in hydrologic studies to define the geologic framework of aquifer systems, to locate hydrologic boundaries, and in some places, to interpret the lithologic character of aquifers and confining beds. High-resolution continuous seismic profiling, through the use of nonexplosive sound sources can be used to produce continuous records that require little data processing before hydrogeologic interpretation. High-resolution tuned transducer, minisparker, Uniboo, and small airgun systems operating from small boats in shallow water are capable of transmitting energy that can penetrate up to a hundred meters of earth materials. The resulting analog records of the reflected seismic signal closely resemble geologic sections. Surveys on the Housatonic River in Connecticut and Massachusetts, and on the Connecticut River, in water from 1 to 10 meters deep, have defined the bedrock surface beneath 60 meters of stratified drift. Seismic-reflection profiling also was used to determine the extent and thickness of recent lake-bottom deposits in two Connecticut lakes. Surveys along 90 kilometers of river channels in the Sarasota-Port Charlotte, Florida area have defined in detail the stratigraphy and continuity of the shallow aquifers. (Author's abstract)
W87-01872

IN REVERSE PROBLEM IN GROUND WATER: MODEL DEVELOPMENT,
Youngstown State Univ., OH. Dept. of Civil Engineering.
I. A. Khan.
Ground Water GRWAAP, Vol. 24, No. 1, p 32-38, January-February, 1986. 5 fig, 14 ref. NSF Grant CEE-8025809.

Descriptors: *Algorithms, *Model studies, *Aquifers, *Inverse problems, Simulation models, Finite difference models.

A model to solve the inverse problem in ground water has been developed. The model consists of an unconstrained multivariable optimization algorithm and a ground-water simulation model. The optimization algorithm is a modified version of Newton's second derivative method. It is a ground-water-specific algorithm and was found to be more efficient than other more general unconstrained optimization algorithms requiring first- and/or second-order derivatives and those requiring no derivatives. The groundwater simulation model is based on a finite-difference technique but it can be replaced easily by a finite-element model. The results of an application of this model to real aquifer are discussed in a companion paper titled 'Inverse Problem in Ground Water: Model Application.' (See also W87-01874) (Author's abstract)
W87-01873

INVERSE PROBLEM IN GROUND WATER: MODEL APPLICATION,
Youngstown State Univ., OH. Dept. of Civil Engineering.
I. A. Khan.
Ground Water GRWAAP, Vol. 24, No. 1, p 39-48, January-February 1986. 14 fig, 6 tab, 9 ref. NSF Grant CEE-8025809.

Descriptors: *Aquifers, *Mathematical models, *Hydraulic conductivity, *Model studies, Finite difference analysis, Miami River Valley, Ohio, Fairfax-New Baltimore aquifer, Storativity, Historical data, Water-table elevations.

The inverse model developed in the companion paper entitled, 'Inverse Problem in Ground Water: Model Development', has been applied to the Fairfax-New Baltimore aquifer in the lower Great Miami River Valley, Ohio. The information obtained from U. S. Geological Survey maps showed four distinct zones of differing hydraulic conductivities in the aquifer. The initial guesses for the hydraulic conductivities were made subjectively. The values of storativity were also assigned subjectively. The inverse model converged within five iterations, and an excellent match with the historical data was obtained. A sensitivity analysis was made to determine the response of the model to various initial guesses for the hydraulic conductivity, various assigned values of storativity and the number of zones. The sensitivity analysis showed that the calculated hydraulic conductivities were insensitive to initial guesses but sensitive to the assigned values of storativity and the number of zones. However, reasonable deviations in the assigned values were absorbed by the surrogate hydraulic conductivity and the model remained a good input-output model. (See also W87-01873) (Author's abstract)
W87-01874

USE OF A NUMERICAL GROUND-WATER FLOW MODEL FOR HYPOTHESIS TESTING,
Wisconsin Univ.-Madison. Dept. of Geology and Geophysics.
D. P. Krabbenhoft, and M. P. Anderson.

Groundwater GRWAAP, Vol. 24, No. 1, p 49-55, January-February 1986. 8 fig, 1 tab, 17 ref. NSF Project DEB 8012313.

Descriptors: *Groundwater movement, *Mathematical models, *Surface-groundwater relations, *Hydraulic gradient, *Seepage, Mathematical studies, Wisconsin, Trout Lake, Aquifers, Glacial-outwash sediments.

A numerical ground-water flow model was applied to isolate the factors that account for an anomalous distribution of seepage and associated hydraulic gradients in a ground water/lake system in northern Wisconsin. The model demonstrates that the hydrologic factors responsible for the anomaly are keys to understanding the dynamics of the entire flow system. Additionally, the study demonstrates the value of ground-water flow models for hypothesis testing and verification of seemingly anomalous field data, which might otherwise be considered suspect and be attributed to faulty instruments. The site modeled in this study is the ground-water flow system along the southeastern shore of Trout Lake, a large kettle lake in northern Wisconsin. The lake is situated in an aquifer consisting of glacial-outwash sediments approximately 50 m thick. Field studies documented the presence of seepage to the lakebed which deviates significantly from the generally accepted dogma that ground-water seepage rates decrease exponentially with distance from shore. The numerical groundwater model facilitated identification of the hydrologic control, namely the presence of a unit of high hydraulic conductivity, that accounts for the anomalous data, and is important for understanding the dynamics of the flow system. Field data including seepage measurements, visual inspection of lakebed materials and springs, and information obtained during drilling, indicate that a lens of coarse grained material was not fully appreciated until a ground-water model was used to simulate the flow system. The model indicated that the presence of the coarse-grained lens has a marked effect on the flow pattern in the nearshore area causing downward hydraulic gradients which divert ground water into the lens and cause the occurrence of a localized high-seepage area offshore where the lens intersects the lake. The numerical model predicts the anomalous seepage distribution noted in the field and the downward hydraulic gradients demonstrating that numerical models are practical tools for interpreting field data and for use in hypothesis testing. (Peters-PTT)
W87-01875

PARAMETER IDENTIFICATION OF A GROUND-WATER CONTAMINANT TRANSPORT MODEL,
Woodward-Clyde Consultants, Walnut Creek, CA.
For primary bibliographic entry see Field 5B.
W87-01876

SIMPLIFIED ANALYSIS OF TWO-WELL TRACER TESTS IN STRATIFIED AQUIFERS,
Auburn Univ., AL. Dept. of Civil Engineering.
O. Guven, R. W. Falta, F. J. Molz, and J. G. Melville.
Ground Water GRWAAP, Vol. 24, No. 1, p 63-71, January-February 1986. 6 fig, 16 ref, append.

Descriptors: *Aquifers, *Groundwater movement, *Computer programs, *Tracers, Aquifer stratification, Mathematical models, Advection pattern, Hydrodynamic dispersion.

Several effects of aquifer stratification on the results of two-well tracer tests are illustrated by means of a simplified computer model. It is assumed that the aquifer is horizontal, confined, of constant thickness and porosity, and perfectly stratified in the vicinity of the test wells. The nonuniform advection pattern is taken into account in detail by the model, but the local hydrodynamic dispersion is completely neglected. This simplified model has been verified in part by comparison with available analytical solutions valid for homogeneous aquifers and in part by comparisons with the results of a two-well field experiment. The applications of the model to several field situations with assumed values of the relevant parameters show that the concentration versus time breakthrough curve measured at the withdrawal well during a standard two-well test would be very sensitive to variations of the hydraulic conductivity in the vertical. Without the use of supplementary observation wells with isolated multilevel sampling points, the standard test would give little useful information about the hydraulic and dispersive characteristics of an aquifer. Factors such as the length of the tracer injection period, the use of recirculation and the physical size of the experiment all have a strong effect on the breakthrough curve measured at the withdrawal well, making the interpretation of field results difficult unless aquifer stratification is measured and taken into account. (Peters-PTT)
W87-01877

AQUIFER TEST ANALYSIS IN FRACTURED ROCKS WITH LINEAR FLOW PATTERN,
King Abdulaziz Univ., Jeddah (Saudi Arabia). Dept. of Hydrology.
Z. Sen.
Ground Water GRWAAP, Vol. 24, No. 1, p 72-78, January-February 1986. 6 fig, 15 ref.

Descriptors: *Groundwater movement, *Aquifers, *Fracture permeability, *Mathematical models, Vertical fracture, Finite width, Linear flow, Drawdown.

Methods for determining aquifer parameters for fractured rocks in which linear flow predominates are presented. Solutions are presented for determining aquifer parameters by convenient type curves for an infinitesimally small or a finite width of vertical fracture from which water is withdrawn. A major vertical fracture in a permeable rock mass may act as an extended well and can provide water through pumping either directly from the fracture itself or if the fracture width is not enough to install pumps, from an abstraction well drilled in the fracture. In such a case, the ground-water flow is not radial but linear toward the fracture and the flow lines are perpendicular to the fracture axis. A mathematical description of ground-water flow toward vertical fractures is presented. The cases considered are: an infinitesimally small fracture width corresponding to a planar source or sink, and a finite width fracture in which the effects of ground-water storage in the fracture are taken in to account. The necessary type curves are presented for the main and observation wells. The type curve in the linear flow pattern case is extremely different from the radial flow solution, especially for long times. Recovery type curves are also given. For small times after the pump-stop, the drawdown in the observation well continues to increase for a while, and then it decreases asymptotically to zero drawdown after the passage of a very long time. For finite width fractures, there are type curves, each one for different storage coefficients. They perform initial straight-line portions representing the fracture storage effect and final straight-line portion which indicated linear flow pattern toward a fracture or solution cavity. (Peters-PTT)
W87-01878

VALUATION OF IMPROVED IRRIGATION EFFICIENCY FROM AN EXHAUSTIBLE GROUNDWATER SOURCE,
Texas A and M Univ., College Station. Dept. of Agricultural Economics and Rural Sociology.
For primary bibliographic entry see Field 3F.
W87-01916

GEOLOGIC INFERENCE FROM 'FLOW NET' TRANSMISSIVITY DETERMINATION: THREE CASE STUDIES,
Battelle Pacific Northwest Labs., Richland, WA.
W. A. Rice, and S. M. Gorelick.
Water Resources Bulletin WARBAQ, Vol. 21, No. 6, p 919-930, December 1985. 17 fig, 1 tab, 22 ref. DOE Contract DE-AC06-76RLO No. 1830.

Descriptors: *Geohydrlogy, *Groundwater movement, *Groundwater, *Parametric hydrology, *Transmissivity, Graphical analysis, Inverse methods, Subsurface geologic structures, Hanford Site, Washington, Rocky Mountain Arsenal, Colorado, Nevada Test Site, Nevada, Bedrock controls, Monte Carlo simulation, Hydraulic gradient.

A graphical inverse method for determining the regional transmissivity distribution was applied to three field problems. These case studies discuss the sensitivity of the technique and its utility in inferring subsurface geologic structures that control groundwater flow. The study areas were the Hanford Site, Washington; the Rocky Mountain Arsenal, Colorado; and the Nevada Test Site, Nevada. The inverse method is graphical because it relies on construction of a 'flow net' over the groundwater domain and then scaling a known transmissivity along each streamtube according to the aspect ratio of each element in the streamtube. This method can aid in flow system conceptualization by revealing the location of bedrock controls for groundwater flow. It is a valuable tool for aiding the hydrogeologist in asking questions about the nature of trends in the pattern of transmissivity values. Quantitative estimates of regional transmissivities can be used as starting points for further parameter refinement. Sensitivity analysis using Monte Carlo simulation shows that quantitative estimates of transmissivity can be obtained when measurement error in the hydraulic head does not cause a large error in the hydraulic gradient. (Peters-PTT)
W87-01927

OPTIMAL STEADY-STATE IN GROUNDWATER MANAGEMENT,
California Univ., Riverside. Dept. of Soil Science and Agricultural Engineering.
For primary bibliographic entry see Field 4B.
W87-01931

AIRBORNE THERMAL MAPPING OF A FLOW-THROUGH LAKE IN THE NEBRASKA SANDHILLS,
Nebraska Univ., Lincoln. Conservation and Survey Div.
For primary bibliographic entry see Field 2H.
W87-01933

ENIWETOK ATOLL ISLAND: GEOTHERMAL SYSTEM IN THE NATURAL STATE, (ATOLL D'ENIWETOK: SYSTEME GEOTHERMIQUE INSULAIRE A L'ETAT NATUREL),
CEA Centre d'Etudes de Bruyeres-le-Chatel, Montrouge (France).
G. Samaden, P. Dallot, and R. Roche.
La Houille Blanche, Vol. 85, No. 2, p 143-151, 1985. 21 fig, 1 tab, 12 ref.

Descriptors: *Atolls, *Eniwetok, *Bikini, *Subsurface temperature, *Groundwater flows, Thermal gradient diffusion, Islands, Permeability, Limestone diagenesis, Mathematical models, Computations.

Deep drilling campaigns were conducted on Eniwetok and Bikini atolls in 1952 and later. They made it possible to measure temperatures to a depth of approximately 1,200 m. A negative temperature gradient was observed. A general model of groundwater flows was developed together with the corresponding computation program. The phenomenon of thermal gradient reversal at the levels measured is explained by the combined effect of diffusion and convection. A five-layer model is used to determine permeability values according to depth and to adjust the computed temperature profile in the lower section of the limestone layer. These results are compared to those obtained by the studies of Cenozoic limestone diagenesis on Eniwetok Atoll. The overall functional models obtained by these two different approaches are satisfactorily complementary and consistent. (Author's abstract)
W87-01970

FLOW AND CONTAINMENT OF INJECTED WASTES,
Du Pont de Nemours (E.I.) and Co., Wilmington, DE. Central Research and Development Dept.

For primary bibliographic entry see Field 5E.
W87-02052

CHEMICAL FATE OF INJECTED WASTES,
Du Pont de Nemours (E.I.) and Co., Wilmington, DE. Engineering Dept.
For primary bibliographic entry see Field 5B.
W87-02054

LABORATORY STUDY OF ELECTROMIGRATION AS A POSSIBLE FIELD TECHNIQUE FOR THE REMOVAL OF CONTAMINANTS FROM GROUND WATER,
For primary bibliographic entry see Field 5G.
W87-02060

WATER WELL INDUSTRY SUPPLIERS,
For primary bibliographic entry see Field 4B.
W87-02073

CORROSION AND INCRUSTATION,
For primary bibliographic entry see Field 8G.
W87-02074

SIMULTANEOUS OUTFLOW OF FRESH WATER AND INFLOW OF SEA WATER IN A COASTAL SPRING,
Montpellier-2 Univ. (France). Lab. d'Hydrogeologie.
C. Drogue, and P. Bidaux.
Nature NATUAS, Vol. 322, No. 6077, p 361-363, July 24, 1986. 4 fig, 13 ref.

Descriptors: *Mediterranean, *Groundwater movement, *Coastal streams, *Saline water intrusion, *Springs, *Hydrodynamics, *Coastal aquifers, *Hydraulics, Flow characteristics, Karst hydrology, Karst, Salinity, Chemical properties, Saline water, Subsurface water, Encroachment.

The simultaneous outflow of fresh water and inflow of salt water at a karstic spring (Source de la Roubine) running into a salt-water lagoon on the French Mediterranean coast was studied. In the absence of rain, rises of several tens of centimeters last from a few hours to 4-5 days. have been observed in the water level near the spring. last from a few hours to 4-5 days. At the same time, a current of salt water runs along the bottom of the channel below the fresh water and in the opposite direction, from there one or two of the springs and entering into the aquifer. Water continues to run out of the other springs and flows toward the lagoon on top of the salt water. It appears that the variations in the water level of the spring are caused by variations in the level of the lagoon on the west bank. Easterly winds cause the water level to rise on the west bank and fall on the east bank, thus setting up a hydraulic gradient in the salt water directed toward the spring. The superposition of the two flows and the low apparent miscibility of the two streams are caused by differences in density. The origin of most of the salinity of the spring, however, is contamination of deep groundwater by the penetration of sea water into the karst. When lagoon water has flowed in, it runs by gravity to the interface of the salt water encroachment and may then be taken by groundwater flow to springs under the lagoon or under the sea. Geological structures which could enable this phenomenon to occur are very common in the limestone coasts around the Mediterranean. (Peters-PTT)
W87-02079

GROUND WATER PLAN HAS REGIONAL FOUNDATION,
Kellogg Corp., Littleton, CO.
For primary bibliographic entry see Field 6A.
W87-02108

AREAS OF EVAPORATIVE DISCHARGE FROM AQUIFERS: LITTLE KNOWN SPANISH ECOSYSTEMS DESERVING PROTECTION,
Universidad Autonoma de Madrid (Spain). Dept. de Ecologia.
F. G. Bernaldez, C. P. Perez, and A. S. Carmona.
Journal of Environmental Management JEVMA, Vol. 21, No. 4, p 321-330, December 1985. 7 fig, 22 ref.

Descriptors: *Aquifers, *Evaporation discharge, *Spain, *Evapotranspiration, Arid climates, Arid lands, Climates, Water policy, Water supply development, Water scarcity.

The ecological functions, impact responses and possible protection policies associated with aquifers in semi-arid areas are reviewed through an examination of the evaporative discharge characteristics of the Madrid, Spain aquifer. The ecological importance of evaporative discharge areas is discussed in terms of climatic influences, variations in landscapes and biogeographical characteristics. The ecological vulnerability of these areas to damage caused by uncontrolled water pumping is described, and several water resource protection policy options are recommended. (Michael - PTT)
W87-02112

INFLUENCE OF DRAINAGE ON N-MINERALIZATION AND VEGETATION RESPONSE IN WET MEADOWS: II. CIRSIO-MOLINIETUM STANDS,
Groningen Rijksuniversiteit (Netherlands). Dept. of Plant Ecology.
For primary bibliographic entry see Field 2I.
W87-02134

AUTOCHTHONOUS BACTERIA IN THE CHALK AND THEIR INFLUENCE ON GROUNDWATER QUALITY IN EAST ANGLIA,
British Geological Survey, Wallingford (England). Hydrogeology Research Group.
For primary bibliographic entry see Field 5B.
W87-02207

ILLUSTRATION AND VERIFICATION OF ADJOINT SENSITIVITY THEORY FOR STEADY STATE GROUNDWATER FLOW,
INTERA Technologies, Inc., Austin, TX.
J. L. Wilson, and D. E. Metcalfe.
Water Resources Research WRERAO, Vol. 21, No. 11, p 1602-1610, November 1985. 4 fig, 3 tab, 18 ref, append.

Descriptors: *Sensitivity analysis, *Steady flow, *Model studies, *Groundwater movement, Hydraulics, Flow characteristics, Statistical models, Mathematical equations, Boundary conditions.

Three one-dimensional flow problems are used to illustrate the application of adjoint sensitivity theory to steady state groundwater flow. Adjoint states are analytically derived for four performance measures: hydraulic head at a point, spatially average hydraulic head, Darcy velocity at a point and flux from a prescribed head boundary Sensitivity coefficients calculated for average head and adjoint states are interpreted and their usefulness discussed. Implementation of a numerical adjoint sensitivity flow code is described and the computed adjoint states are used in the code to evaluate sensitivities of model results to model input parameters. The one-dimensional flow problems are used to verify the numerical code. Both the analytically derived adjoint states, including those involving jump conditions, and nonlinear sensitivity coefficients for model output values are successfully reproduced. (Michael-PTT)
W87-02272

DEVELOPMENT OF MULTIPLE SEEPAGE FACES ON LAYERED SLOPES,
British Columbia Univ., Vancouver. Dept. of Geological Sciences.
J. J. Rulon, R. Rodway, and R. A. Freeze.
Water Resources Research WRERAO, Vol. 21, No. 11, p 1625-1636, November 1985. 17 fig, 5 tab, 18 ref, append.

Descriptors: *Seepage, *Slopes, *Geomorphology, *Mathematical models, *Groundwater movement, Water table profiles, Hydraulic gradient, Hydraulic conductivity, Hydraulic models, Steady flow, Aeration zone, Slope stability, Flow measurement, Erosion, Drainage patterns.

Water table configuration and hydraulic-head distribution in layered hillsides was analyzed. A finite-element model simulated two-dimensional, saturated-unsaturated steady state flow through layered slopes. A laboratory sand tank experiment was used to verify the model. Layered slopes featured multiple seepage faces, perched water tables and wedge-shaped unsaturated zones. Hydraulic-head distribution and water table configuration were dependent on the position of impending layers and the ratio of hydraulic conductivity between adjacent layers. This work has geotechnical implications in terms of slope stability and control of groundwater into excavations, geomorphological implications with respect to landform development by mass movements and surface water erosion and hydrogeological implications in regard to flow path analysis in contamination studies. Appendix includes experimental data. (Michael-PTT)
W87-02274

FLOW TO A WELL IN A MULTIAQUIFER SYSTEM,
Lincoln Coll. (New Zealand). Dept. of Civil Engineering.
B. Hunt.
Water Resources Research WRERAO, Vol. 21, No. 11, p 1637-1641, November 1985. 3 fig, 2 tab, 13 ref.

Descriptors: *Well hydraulics, *Groundwater movement, *Flow profiles, *Aquifer characteristics, *Mathematical models, Mathematical equations, Steady flow, Unsteady flow, Eigenvalue problems.

Solutions are calculated for steady and unsteady flow to a well in a multiaquifer system with N-horizontal aquifers. Aquifer and aquitard properties may vary among layers, but are assumed to be constant in the horizontal direction. Closed form solutions first require solution of generalized eigenvalue problems for numerical evaluation. The matrices appearing in these problems are symmetric and positive definite thus proving that eigenvalues are real and positive and that a solution always exists. A solution is presented for a numerical example involving flow to a well in a system of five aquifers. (Author's abstract)
W87-02275

FIELD DETERMINATION OF THE THREE-DIMENSIONAL HYDRAULIC CONDUCTIVITY TENSOR OF ANISOTROPIC MEDIA: 1. THEORY,
Geological Survey, Menlo Park, CA.
P. A. Hsieh, and S. P. Neuman.
Water Resources Research WRERAO, Vol. 21, No. 11, p 1655-1665, November 1985. 14 fig, 17 ref, 6 append.

Descriptors: *Hydraulic conductivity, *Groundwater movement, *Anisotropy, *Tensile stress, Boreholes, Borehole geophysics, Monitoring, Injection, Selective withdrawal, Hydraulic models, Model studies, Mathematical equations.

A field method for determining three-dimensional conductivity tensor and specific storage of an anisotripic porous or fractured medium is proposed. This cross-hole testing method consists of fluid injection into or withdrawal from packed-off intervals in a number of boreholes and monitoring the transient head response in neighboring boreholes. This method provides direct field information on whether it is proper to regard the medium as uniform and anisotropic on the scale of the test. Theoretical expressions decribing transient and steady state head response in monitoring intervals of arbitrary lengths and orientations to constant rate injection/withdrawal intervals of similar or different lengths and orientations are presented. The conditions under which these intervals can be treated as mathematical points are explored through asymtotic analysis. The theory of images

is used to analyze the effect of planar no-flow and constant-head boundaries on transient and steady state head response. (See also W87-02279) (Author's abstract)
W87-02278

FIELD DETERMINATION OF THREE-DIMENSIONAL HYDRAULIC CONDUCTIVITY TENSOR OF ANISOTROPIC MEDIA: 2. METHODOLOGY AND APPLICATION TO FRACTURED ROCKS,
Geological Survey, Menlo Park, CA.
P. A. Hsieh, S. P. Neuman, G. K. Stiles, and E. S. Simpson.
Water Resources Research WRERAQ, Vol. 21, No. 11, p 1667-1676, November 1985. 15 fig, 4 tab, 10 ref. NRC Contract NRC-04-78-275.

Descriptors: *Groundwater movement, *Hydraulic conductivity, *Anisotropy, *Field tests, *Tensile stress, *Boreholes, Borehole geophysics, Monitoring, Injection, Selective withdrawal, Hydraulic models, Arizona, Geologic fractures, Granite, Mathematical equations, Statistical analysis.

Methods for interpreting the results of cross-hole tests in anisotripic porous or fractured media are described. Test results can be analyzed graphically in cases where injection and monitoring intervals are short in relation to distance between them. Directional hydraulic diffusivity and quantity can be determined by curve matching from the transient variation of hydraulic head in a given monitoring interval. The principal values and direction of the hydraulic conductivity tensor can be evaluated by fitting an ellipsoid to the square roots of the directional diffusivities. Six directional measurements are generally required, but a larger number may be needed to fit an ellipsoid to the data by least squares. If computed values fluctuate so severely that a meaningful least squares fit is not possible, the subsurface may not behave as a uniform anisotropic medium on the scale of the test. Test results from a granitic rock near Oracle, AZ illustrate how the method works for fractured rocks. Oracle granite is shown to respond as a near uniform, anisotropic medium and its hydraulic conductivity is strongly controlled by the orientations of major fracture sets. Cross-hole test results are consistent with the results of more than than 100 single-hole packer tests conducted at the site. (See also W87-02278) (Author's abstract)
W87-02279

ANALYSIS OF HYDRODYNAMIC DISPERSION IN DISCRETE FRACTURE NETWORKS USING THE METHOD OF MOMENTS,
Royal Inst. of Tech., Stockholm (Sweden). Dept. of Chemical Engineering.
For primary bibliographic entry see Field 5B.
W87-02280

ASSESSMENT OF THE INSTANTANEOUS UNIT HYDROGRAPH DERIVED FROM THE THEORY OF TOPOLOGICALLY RANDOM NETWORKS,
Geological Survey, Lakewood, CO. Water Resources Div.
M. R. Karlinger, and B. M. Troutman.
Water Resources Research WRERAQ, Vol. 21, No. 11, p 1693-1702, November 1985. 13 fig, 1 tab, 11 ref.

Descriptors: *Unit hydrographs, *Rainfall-runoff relationships, *Networks, *Topology, Basins, Hydraulics, Linear programming, Sensitivity analysis, Hydrology, Mathematical equations, Mathematical models, Probabilistic process, Alabama, Kentucky.

An instantaneous unit hydrograph (iuh) based on the theory of topologically random networks (topological iuh) was evaluated in terms of basin characteristics and hydraulic parameters. Hydrographs, computed using linear routing methods for each of two drainage basins in Alabama and Kentucky, were the basis for comparing topological iuh's. Elements in sets of basin characteristics for the topological iuh's are the number of first-order streams only or the number of sources together with the number of channel links in the topological diameter. Hydraulic parameters are the values of celerity and diffusivity constant. Sensitivity analyses indicate that the mean celerity of internal links in the network is the critical hydraulic parameter for determining the shape of the topological iuh, while the diffusivity constant has only minimal influence. Asymptotic analysis does not require a large number of sources to approximate the topological iuh with the Weibull probability density function. (Author's abstract)
W87-02282

COMPUTATIONALLY EFFICIENT ALGORITHMS FOR PARAMETER ESTIMATION AND UNCERTAINTY PROPAGATION IN NUMERICAL MODELS OF GROUNDWATER FLOW,
Western Australia Univ., Nedlands. Centre for Water Research.
L. R. Townley, and J. L. Wilson.
Water Resources Research WRERAQ, Vol. 21, No. 12, p 1851-1860, December 1985. 4 fig, 31 ref, append.

Descriptors: *Estimating equations, *Mathematical models, *Groundwater movement, *Parametric hydrology, Numerical analysis, Boundary conditions, Statistical methods, Statistical analysis, Statistical models, Aquifer characteristics, Computer programs.

Computational algorithms are presented for steady and transient models in which aquifer storage coefficients, transmissivities, distributed inputs and boundary values can be simultaneously uncertain. Features of these algorithms include: a new form of generalized boundary condition; a concise discrete derivation of the adjoint problem for transient models with variable time steps; an efficient technique for calculating the approximate second derivative during line searches in weighted least squares estimation; and, a new first-order, second-movement algorithm for calculating covariance of predicted heads due to a large number of uncertain parameter values. These techniques are presented in matrix form and their efficiency depends on the structure of sparse matrices that occur repeatedly throughout the calculations. Details of matrix structures are provided for a two-dimensional linear triangular finite element model. (Author's abstract)
W87-02301

HYDROLOGIC MECHANISMS GOVERNING FLUID FLOW IN A PARTIALLY SATURATED, FRACTURE, POROUS MEDIUM,
California Univ., Berkeley. Earth Sciences Div.
J. S. Y. Wang, and T. N. Narasimhan.
Water Resources Research WRERAQ, Vol. 21, No. 12, p 1861-1874, December 1985. 17 fig, 1 tab, 26 ref, append. DOE Contract DE-AC03-76SF00098.

Descriptors: *Fluid flow, *Groundwater movement, *Hydrologic properties, *Partially saturated flow, Statistical analysis, Statistical methods, Geologic fractures, Saturated flow, Saturation, Hydraulic conductivity, Pressure distribution, Simulation analysis, Drainage, Porosity, Yucca Mountain, Tuff, Mathematical equations, Fluid mechanics.

A conceptual model of the hydrology of a partially saturated, fractured, porous medium is presented. A general statistical theory for flow along the fractures and between the matrix blocks and the fractures under partially saturated conditions is constructed. Results obtained from a simple statistical aperture distribution model for fracture saturation, hydraulic conductivity and the effective matrix-fracture flow area as functions of pressure are presented. Drainage from a column of fractured tuff is simulated using available parameters for the densely welded tuff of the Topopah Spring Member at Yucca Mountain in southern Nevada. From the cases simulated for the fractured porous columns with discrete vertical and horizontal fractures and porous matrix blocks explicitly accounted for, it is observed that highly transient changes from fully saturated to partially saturated conditions are extremely sensitive to fracture properties. Nevertheless, the quasi-steady changes of the fluid flow of a partially saturated, fractured, porous system can be approximately simulated without taking the fractures into account. (Michael-PTT)
W87-02302

SCATTERING FUNCTIONS AND INFILTRATION,
Commonwealth Scientific and Industrial Research Organization, Canberra (Australia). Div. of Environmental Mechanics.
For primary bibliographic entry see Field 2G.
W87-02304

STEADY STATE FLOW PASSING THROUGH A CYLINDER OF PERMEABILITY DIFFERENT FROM THE SURROUNDING MEDIUM,
Nevada Univ. System, Reno. Desert Research Inst.
S. W. Wheatcraft, and F. Winterberg.
Water Resources Research WRERAQ, Vol. 21, No. 12, p 1923-1929, December 1985. 8 fig, 8 ref. DOE Contract DE-AC08-85NV10384.

Descriptors: *Steady flow, *Permeability, *Groundwater movement, Porosity, Flow pattern, Flow profiles, Mathematical equations, Flow measurements, Hydrologic models, Contamination, Boreholes.

Solutions for flow through a cylinder are developed, analyzed and verified. A generalized method by which a cylinder of permeability is embedded in the surrounding porous medium is presented. This method is valid for any complex potential flow field that obeys the Laplace equation. Cases of flow to a well and uniform lateral flow with an embedded cylinder are reviewed to demonstrate the general applicability of the method. Equations are obtained for the relative amount of flow passing through the cylinder compared to the surrounding medium. This method has potential applications in contaminant transport problems and for the direct measurement of groundwater velocity in boreholes. (Michael-PTT)
W87-02308

WATER FLOW AND SOLUTE TRANSPORT PROCESSES IN THE UNSATURATED ZONE,
California Univ., Davis. Dept. of Land, Air and Water Resources.
For primary bibliographic entry see Field 2G.
W87-02319

SIMULATION OF NONAQUEOUS PHASE ORGANIC COMPOUNDS IN THE SUBSURFACE,
Princeton Univ., NJ. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5B.
W87-02320

STATISTICAL THEORY OF GROUNDWATER FLOW AND TRANSPORT: PORE TO LABORATORY, LABORATORY TO FORMATION, AND FORMATION TO REGIONAL SCALE,
Tel-Aviv Univ. (Israel). Faculty of Engineering.
G. Dagan.
Water Resources Research WRERAQ, Vol. 22, No. 9, p 120S-134S, August 1986. 7 fig, 1 tab, 46 ref.

Descriptors: *Groundwater movement, *Flow profile, *Porous media, *Model studies, Hydraulic conductivity, Transmissivity, Pore water, Statistical analysis, Theoretical analysis, Mathematical studies, Flow domains.

The statistical approach has been applied increasingly to groundwater flow problems in the last decade. This development has been motivated by the recognition of the fact that porous formations are heterogeneous, i.e., with properties which vary in an irregular manner in space. Flow domains are characterized by the length scale L of their spatial extent and three such scales of a fundamental nature are introduced: the laboratory, the local, and the regional scale. Heterogeneity is characterized by the spatial correlation scale I of the property of interest, the three scales corresponding to the above ones being the pore scale, the log hydraulic

conductivity, and the log transmissivity integral scales. The medium properties and related flow variables are regarded as random space functions which satisfy two basic requirements: they enjoy some type of stationarity and I << L. An additional scale D is the measurement or computational scale, characterizing the size of the measurement device of a flow variable or the element over which the variable is averaged for computational purposes. In both cases, the interest resides in the space average of the flow variable over a volume or area of length scale D. The primary aim of the theory of flow and transport through porous media is to determine the statistical moments of the space-averaged variables, given the statistical structure of the spatially variable property. The main objective of the study is to show that flow and transport problems at the three fundamental scales can be treated by a unified statistical approach, along this line. The specific aspects of each scale are examined Separately, and areas of interest for future research are indicated. In the concluding remarks it is submitted that the statistical approach to groundwater flow has become a comprehensive theory, beyond the stage of an ad hoc modeling technique. (Author's abstract)
W87-02321

STOCHASTIC SUBSURFACE HYDROLOGY FROM THEORY TO APPLICATIONS,
Massachusetts Inst. of Tech., Cambridge. Dept. of Civil Engineering.
L. W. Gelhar.
Water Resources Research WRERAQ, Vol. 22, No. 9, p 135S-145S, August 1986. 12 fig, 2 tab, 44 ref. NSF Grants ECE-8311786 and INT-8212574; TVA Contract TV-61664A.

Descriptors: *Groundwater movement, *Stochastic hydrology, *Subsurface water, *Theoretical analysis, *Flow profiles, Heterogeneity, Aquifers, Hydraulic conductivity, Dispersivity, Monte Carlo Method, Statistical analysis, Mathematical studies.

Research on the stochastic analysis of subsurface flow has developed rapidly in the last decade, but applications of this approach have been very limited. Illustrated here is how currently available techniques and results can be used to answer important questions about the large-scale behavior of naturally heterogeneous aquifers. Perturbation-based spectral theory, which presumes local statistical homogeneity, provides generic theoretical results for the head variance effective conductivity tensor, and macrodispersivity tensor in a field. These results emphasize the key role fo the variance and spatial correlation scales of the log hydraulic conductivity field. Field information of variances and correlation scales of natural materials is summarized. The validity of some of the generic stochastic results is evaluated through comparison with Monte Carlo simulations and field observations. A specific field application example is developed to illustrate how the stochastic results are used to estimate large-scale parameters and determine the reliability of three-dimensional numerical simulations. Using typical log conductivity covariance parameters, the effective hydraulic conductivity tensor, and the macrodispersivity tensor are estimated. The calculated head variance, based on the simulated mean hydraulic gradient, is used as a measure of the adequacy of the calculation of the steady state flow model. Discussion emphasizes limitations and extensions of this approach, and ongoing field evaluations of the results. (Author's abstract)
W87-02322

MIXING EFFECTS OF CARBONATE DISSOLVING WATERS ON CHEMICAL AND 13-C/12-C COMPOSITIONS,
Marie Curie-Sklodowska Univ., Lublin (Poland). Inst. of Physics.
For primary bibliographic entry see Field 2K.
W87-02329

ANALYSIS OF THE EPHEMEROPTERA-EMERGENCE OF THE BREITENBACH NEAR SCHLITZ/HESSE (F.R.G.), (ANALYSE DER EPHERMEROPTERA-JAHRESEMERGENZ DES BREITENBACHES BEI SCHLITZ/HESSEN (BUNDESREPUBLIK DEUTSCHLAND)),
For primary bibliographic entry see Field 2H.
W87-02344

PILOT PLANT STUDY ON WATER QUALITY CHANGES DURING GROUNDWATER RECHARGE,
Ministerie van Volksgezondheid en Milieuhygiene, Leidschendam (Netherlands).
For primary bibliographic entry see Field 5E.
W87-02358

ORGANIC INDICATORS OF GROUNDWATER POLLUTION BY A SANITARY LANDFILL,
Consejo Superior de Investigaciones Cientificas, Madrid (Spain).
For primary bibliographic entry see Field 5A.
W87-02362

DESIGN AND PERFORMANCE OF SINGLE-WELL TRACER TESTS AT THE MOBILE SITE,
Auburn Univ., AL. Dept. of Civil Engineering.
F. J. Molz, J. G. Melville, O. Guven, R. D. Crocker, and K. T. Matteson.
Water Resources Research WRERAQ, Vol. 21, No. 10, p 1497-1502, October 1985. 11 fig, 2 tab, 9 ref. EPA Agreement CR 810704-01-0.

Descriptors: *Performance evaluation, *Design standards, *Tracer studies, *Test wells, *Mobile, *Alabama, Observation wells, Peristaltic pumps, Hydraulic properties, Hydraulic conductivity, Permeability, Injection wells.

Tracer tests are the most reliable field methods for obtaining information describing advection and dispersion in aquifers. This paper describes the design and performance of single-well tracer tests utilizing multilevel observation wells at a field site near Mobile, Alabama. In a given observation well, a total of 7 sampling zones were isolated using inflatable packers and silicone rubber plugs. All instrumentation was contained within a removable insert that extended from the well bottom to the land surface. Each sampling zone contained an electrical conductivity probe and was connected to the surface with two lengths of vacuum tubing. When combined with peristaltic pumps, the tubing allowed mixing of the sampling zone contents as well as water sample collection. A total of 5 experiments were performed using bromide as a conservative tracer. Results showed that the sampling zones were well isolated and that sampling zone mixing was necessary to achieve results that were independent of probe placement within a given zone. Both electrical conductivity and bromide concentration breakthrough curves indicated the presence of a high horizontal permeability zone in the bottom third of the aquifer, although the concentration data were considered the more accurate and reliable. Permeability values based on tracer travel times from the injection-recovery well to the multilevel observation well varied by a factor of 4 over the aquifer thickness. Such results are reasonably consistent with permeability trends inferred during thermal energy storage experiments performed previously at the same site. (Author's abstract)
W87-02379

COMPARISON OF SEVERAL METHODS OF SOLVING NONLINEAR REGRESSION GROUNDWATER FLOW PROBLEMS,
Geological Survey, Lakewood, CO. Water Resources Div.
R. L. Cooley.
Water Resources Research WRERAQ, Vol. 21, No. 10, p 1525-1538, October 1985. 5 fig, 16 tab, 21 ref, 2 append.

Descriptors: *Groundwater movement, *Flow profiles, *Statistical methods, *Computer models, Aquifers, Regression analysis, Statistical analysis, Marquardt Method, Newton Method, Fletcher-Reeves Method, Computers.

Computational efficiency and computer memory requirements for four methods of minimizing functions were compared for four test nonlinear-regression steady state groundwater flow problems. The fastest methods were the Marquardt and quasi-linearization methods, which required almost identical computer times and numbers of iterations; the next fastest was the quasi-Newton method, and last was the Fletcher-Reeves method, which did not converge in 100 iterations for two of the problems. The fastest method per iteration was the Fletcher-Reeves method, and this was followed closely by the quasi-Newton method. The Marquardt and quasi-linearization methods were slower. For all four methods the speed per iteration was directly related to the number of parameters in the model. However, this effect was much more pronounced for the Marquardt and quasi-linearization methods than for the other two. Hence the quasi-Newton (and perhaps Fletcher-Reeves) method might be more efficient than either the Marquardt or quasi-linearization methods if the number of parameters in a particular model were large, although this remains to be proven. The Marquardt method required somewhat less central memory than the quasi-linearization method for three of the four problems. For all four problems the quasi-Newton method required roughly two thirds to three quarters of the memory required by the Marquardt method, and the Fletcher-Reeves method required slightly less memory than the quasi-Newton method. Memory requirements were not excessive for any of the four methods. (Author's abstract)
W87-02382

EMPIRICAL FUNCTION TO DESCRIBE MEASURED WATER DISTRIBUTIONS FROM HORIZONTAL INFILTRATION EXPERIMENTS,
Iowa State Univ., Ames. Dept. of Agronomy.
For primary bibliographic entry see Field 2G.
W87-02383

GEOCHEMISTRY OF GROUNDWATER IN CRETACEOUS SEDIMENTS OF THE SOUTHEASTERN COASTAL PLAIN OF EASTERN MISSISSIPPI AND WESTERN ALABAMA,
Geological Survey, Atlanta, GA.
For primary bibliographic entry see Field 2K.
W87-02384

MODELING THREE-DIMENSIONAL FLOW IN CONFINED AQUIFERS BY SUPERPOSITION OF BOTH TWO- AND THREE-DIMENSIONAL ANALYTIC FUNCTIONS,
Indiana Univ. at Bloomington. School of Public and Environmental Affairs.
H. M. Haitjema.
Water Resources Research WRERAQ, Vol. 21, No. 10, p 1557-1566, October 1986. 10 fig, 23 ref.

Descriptors: *Groundwater movement, *Aquifers, *Mathematical models, Confined aquifers, Mathematical analysis, Flow profiles, Hydrologic models.

A technique is presented to incorporate three-dimensional flow in a Dupuit-Forchheimer model. It is based on the superposition of approximate analytic solutions to both two- and three-dimensional flow features in a confined aquifer of infinite extent. Three-dimensional solutions are used in the domain of interest, while farfield conditions are represented by two-dimensional solutions. Approximate three-dimensional solutions have been derived for a partially penetrating well and a shallow creek. Each of these solutions satisfies the condition that no flow occurs across the confining layers of the aquifer. Because of this condition, the flow at some distance of a three-dimensional feature, its three-dimensional solution is replaced by a corresponding two-dimensional one. The latter solution is trivial as compared to its three-dimensional counterpart, and its use greatly enhances the computational efficiency of the model. As an example, the flow is modeled between a partially penetrating well and a shallow creek that occur in a regional aquifer system. (Author's abstract)
W87-02385

HEAT PUMP ON GROUND WATER AND COMBINED SOLAR/GEOTHERMAL POWER. A PILOT OPERATION ON 224 DWELLINGS AT AULNAY-SOUS-BOIS, (POMPE A CHALEUR SUR NAPPE ET HELIOGEOTHERMIE. UNE OPERATION PILOTE SUR 224 LOGEMENTS A AULNAY-SUR-BOIS),
Ecole Nationale Superieure des Mines de Paris, Fontainebleau (France). Centre d'Information Geologique.
For primary bibliographic entry see Field 4B.
W87-02423

STORAGE IN A DEEP AQUIFER AT HIGH TEMPERATURE. PILOT PLANT IN PLAISIR, (STOCKAGE EN NAPPE PROFONDE A HAUTE TEMPERATURE. PILOTE DE PLAISIR),
CEA Centre d'Etudes Nucleaires de Saclay, Gif-sur-Yvette (France).
For primary bibliographic entry see Field 4B.
W87-02425

SECOND ANNUAL EASTERN REGIONAL GROUND WATER CONFERENCE.
National Water Well Association, Worthington, OH.
Available from the National Water Well Association, 500 W. Wilson Bridge Road, Worthington, OH. 43085. July 16-18, 1985, Portland, Maine, 1985. 579 p.

Descriptors: *Conferences, *Groundwater, *Groundwater management, *Groundwater pollution, Groundwater movement, Acid rain, Geohydrology, Geophysics, Information exchange.

This conference covered several topics, including leaking underground storage tanks, surface geophysics in groundwater investigations, groundwater contamination and remediation, groundwater and contamination flow through fractured rock, groundwater development in coastal areas, acid rain, groundwater management and regulatory considerations. Government officials, consulting geologists, engineers and researchers, industry representatives and other interested persons met to learn and discuss state-of-the-art techniques employed in groundwater studies. The conference provided a forum for all who attended to communicate and share their experiences in the subject areas discussed at the conference. These proceedings are a compilation of papers presented by the conference speakers. (See also W87-02438 through W87-02475) (Lantz-PTT)
W87-02437

STEP-BY-STEP APPROACH TO GROUNDWATER CONTAMINATION PROBLEMS,
Massachusetts Dept. of Environmental Quality Engineering, Boston.
For primary bibliographic entry see Field 5B.
W87-02438

HYDROGEOCHEMISTRY OF RADON IN GROUND WATER,
Maine Geological Survey, Augusta.
For primary bibliographic entry see Field 2K.
W87-02442

RADON GAS IN GROUND WATER OF NEW HAMPSHIRE,
Minnesota Univ., St. Paul.
For primary bibliographic entry see Field 5B.
W87-02443

EFFECTS OF SUBURBAN DEVELOPMENT ON THE GROUNDWATER OF THE STOCKTON FORMATION BUCKINGHAM TOWNSHIP, BUCKS COUNTY, PENNSYLVANIA,
Woodward-Clyde Consultants, Plymouth Meeting, PA.
For primary bibliographic entry see Field 4C.
W87-02444

WATER-QUALITY IN SAND AND GRAVEL AQUIFERS IN MAINE: THE INFLUENCE OF ACID DEPOSITION, AGRICULTURE, AND OTHER NON-POINT CONTAMINATION SOURCES,
Maine Dept. of Environmental Protection, Augusta.
For primary bibliographic entry see Field 5B.
W87-02445

UNDERGROUND TANKS THREATEN GROUND WATER QUALITY,
Massachusetts Audubon Society, Lincoln.
For primary bibliographic entry see Field 5B.
W87-02446

NEW REQUIREMENTS FOR UNDERGROUND STORAGE TANKS,
Environmental Protection Agency, Washington, DC.
For primary bibliographic entry see Field 5G.
W87-02447

UNDERGROUND TANK PRIORITIZATION - WHERE DO WE START. PLANNING AND IMPLEMENTING AN UNDERGROUND TANK MANAGEMENT PROGRAM FOR A MULTI-SITE/ MULTI-TANK FACILITY,
RMT, Inc., Madison, WI.
For primary bibliographic entry see Field 5G.
W87-02448

AVAILABLE TECHNOLOGY FOR THE MONITORING OF UNDERGROUND STORAGE TANKS,
Veterans Administration Hospital, Denver, CO.
For primary bibliographic entry see Field 5G.
W87-02449

SUBSURFACE MONITORING TECHNIQUES FOR THE DETECTION OF LEAKS NEAR GASOLINE UNDERGROUND STORAGE TANKS,
New Hampshire Water Supply and Pollution Control Commission, Concord.
For primary bibliographic entry see Field 5B.
W87-02450

REPLACEMENT OF SALT CONTAMINATED WATER SUPPLIES IN BEDROCK AQUIFERS IN MAINE,
Maine Dept. of Transportation, Augusta.
For primary bibliographic entry see Field 5C.
W87-02451

LOCATING AND EVALUATING POTABLE WATER SUPPLIES IN AN EXTENSIVELY MINED AREA: A CASE HISTORY,
SRW Associates, Inc., Pittsburgh, PA.
For primary bibliographic entry see Field 4B.
W87-02452

ELECTRICAL RESISTIVITY/TERRAIN CONDUCTIVITY SURVEYS TO TRACE PROCESS WASTEWATER LEACHATE IN GROUNDWATER FROM A SPRAY IRRIGATION SYSTEM,
Jordan Gorrill Associates, Portland, ME.
For primary bibliographic entry see Field 7B.
W87-02454

MONITORING PLUME MIGRATION USING GROUND SURFACE CONDUCTIVITY,
Empire-Thomsen, Groton, NY.
For primary bibliographic entry see Field 5B.
W87-02455

CONVENTIONAL AND STATE-OF-THE-ART GEOPHYSICAL TECHNIQUES FOR FRACTURE DETECTION,
Weston Geophysical Corp., Westborough, MA.
For primary bibliographic entry see Field 7B.
W87-02456

CONTINUOUS SEISMIC-REFLECTION PROFILING OF A GLACIAL-DRIFT DEPOSIT ON THE SACO RIVER, MAINE AND NEW HAMPSHIRE,
Geological Survey, Augusta, ME. Water Resources Div.
For primary bibliographic entry see Field 7B.
W87-02457

GROUNDWATER DEVELOPMENT AND MANAGEMENT PLANNING FOR THE COASTAL PLAIN OF NEW JERSEY,
Camp, Dresser and McKee, Inc., Boston, MA.
For primary bibliographic entry see Field 4B.
W87-02458

RECENT ASSESSMENT OF THE HYDROGEOLOGY AND GROUNDWATER AVAILABILITY OF THE NORTHERN NEW JERSEY COASTAL PLAIN AQUIFERS,
Jordan (Edward C.) Co., Inc., Portland, ME.
M. Miremadi, and W. Murray.
IN: The Second Annual Eastern Regional Ground Water Conference, July 16-18, 1985, Portland, Maine. 1985. p 320-339, 4 fig, 2 tab, 18 ref.

Descriptors: *Geohydrology, *Groundwater potential, *Coastal plains, *Coastal aquifers, *New Jersey, Groundwater management, Saline water intrusion, Groundwater potential, Groundwater mining, Groundwater movement.

A hydrogeologic study was completed for the five major aquifers of the northern New Jersey coastal plain. The aquifers and interbedded confining layers form a wedge of unconsolidated sand, silt and clay which outcrops to the west and dips beneath the Atlantic Ocean to the east. Piezometric and groundwater diversion data for 1983 were obtained from the U.S. Geological Survey and New Jersey Department of Environmental Protection to evaluate the effects of increased water use in the last five years. A groundwater mass balance was completed to assess the availability of additional groundwater supplies and the potential for saltwater encroachment. The 1983 piezometric levels show that the regional drawdowns have decreased less since 1978 indicating a trend toward equilibrium in the aquifers between total recharge, groundwater pumping and natural discharge to the Atlantic Ocean. The mass water balance shows both groundwater surpluses and deficits in different portions of the aquifers. Areas showing groundwater deficits have the greatest potential for saltwater intrusion. Results of the mass balance analysis suggested that the Magothy-Raritan Formation shows the most potential for additional groundwater withdrawal. Modeling of 3510 sq miles, suggests that the drawdown in the area of the proposed withdrawal does not have a significant effect on the current piezometric surface. The study shows the value of combining analytical methods with groundwater flow models in evaluating groundwater availability and regional aquifer management. (See also W87-02437) (Lantz-PTT)
W87-02459

EVALUATION OF GROUND WATER WELL SUPPLIES IN COASTAL NEW HAMPSHIRE BY UTILIZING SURFACE PIEZOMETRIC INFORMATION,
New Hampshire Univ., Durham.
For primary bibliographic entry see Field 4B.
W87-02460

MEAN SEA LEVEL - AN ELUSIVE BOUNDARY,
Santa Clara Univ., CA. Dept. of Civil Engineering.
D. W. Urish, and M. M. Ozbilgin.
IN: The Second Annual Eastern Regional Ground Water Conference, July 16-18, 1985, Portland, Maine. 1985. p 348-358, 6 fig, 1 tab, 12 ref.

Descriptors: *Sea level, *Boundary conditions, *Coastal aquifers, *Groundwater, *Saline water intrusion, Tidal hydraulics, Tides, Piezometers, Mathematical studies.

In many island and coastal groundwater problems the position of the groundwater - free sea water

interface is an essential, but highly dynamic boundary. Within usual tidal ranges this boundary easily fluctuates as much as 5 ft vertically, and on a sandy beach, as much as 200 ft horizontally. The fluctuating boundary commonly is simplified to a fixed position in problem formulation. This fixed position is frequently taken as the location of local mean free water level (Mean sea level) in the adjacent salt water body. While various techniques are available to determine local mean sea level, all are difficult because of the dynamic nature of the coastal margin. More importantly, none really give the boundary position to which the fresh groundwater of a phreatic aquifer responds. Both theoretical analysis an field investigations of coastal groundwater conditions indicate an effective boundary significantly higher than local mean sea level. Tidal fluctuation and wave runup on a sloping beach cause a mounding of sea water in the upper beach with a consequent effective mean sea level as much as 2 ft higher than local mean sea level. This phenomenon is particularly important in the small island and in near-coast situations where Ghyben-Herzberg relationship is applied in conjunction with field water table measurements to estimate the characteristics of the fresh water lens. In coastal hydrological situations a good approximation for the vertical position of the groundwater - free sea water boundary is the mean equivalent salt water head in a fully screened piezometer located in the beach near the upper swash line. This is effective mean sea level. The horizontal position of the boundary is then the intersection of effective mean sea level with the beach face. The veracity of this technique is demonstrated by field research in a New England barrier beach. (See also W87-02437) (Author's abstract)
W87-02461

HYDROGEOLOGIC STUDIES IN CRYSTALLINE FRACTURED ROCK,
Woodward-Clyde Consultants, Wayne, NJ.
D. R. Ganser, P. G. Henning, and R. J. Henning.
IN: The Second Annual Eastern Regional Ground Water Conference, July 16-18, 1985, Portland, Maine. 1985. p 361-383, 10 fig, 1 tab, 13 ref.

Descriptors: *Geohydrology, *Geologic fractures, *Crystalline rocks, *Groundwater movement, Hydraulic properties, Stress, Permeability, Geophysics, Drilling, Boreholes, Cost analysis.

A review of the controlling factors of groundwater flow in fractured crystalline rocks, demonstrates that fracture frequency, fracture aperture and the hydraulic connection (influenced by persistence or continuity) are the primary factors influencing the overall permeability of rock formations. Because permeability is a function of the aperture cubed and because fracture aperture is a function of rock stress, the overall bedrock stress in the area of interest is also an important criteria. A complete study of fracture flow should include several investigative techniques which compliment each other together providing the most thorough understanding of subsurface conditions. These include remote sensing/ lineament analysis, geologic mapping, geophysics, drilling, and borehole logging and testing. The case histories presented indicate how solutions to characterizing subsurface flow in crystalline rocks can be cost-effectively realized. The use of remote sensing and geophysical techniques allow more efficient planning of a drilling program. Special drilling and borehole testing methods can then provide the specific parameters necessary for the hydrologic analysis. The investigative emphasis should not be on one component of the investigation but on the sum of all information gathered by all techniques. (See also W87-02437) (Lantz-PTT)
W87-02462

COMMON PROBLEMS ENCOUNTERED WHEN EVALUATING CONTAMINANT MIGRATION IN BEDROCK: A SURVEY OF CASE HISTORIES IN NEW ENGLAND,
GHR Engineering Associates, Inc., New Bedford, MA.
For primary bibliographic entry see Field 5B.
W87-02463

IDENTIFICATION AND ASSESSMENT OF OVERBURDEN AND FRACTURED BEDROCK AQUIFERS AT SELECTED HAZARDOUS WASTE SITES IN NEW HAMPSHIRE,
For primary bibliographic entry see Field 5B.
W87-02465

GROUND WATER MONITORING AT A HAZARDOUS WASTE FACILITY LOCATED OVER FRACTURED VOLCANIC ROCK,
For primary bibliographic entry see Field 7B.
W87-02466

POTENTIAL IMPACTS OF ACIDIC PRECIPITATION ON A SOLE-SOURCE AQUIFER,
New York State Legislative Commission on Water Resources Needs of Long Island, Hauppauge.
For primary bibliographic entry see Field 5B.
W87-02467

EFFECTS OF ACID PRECIPITATION ON GROUND WATER QUALITY IN THE NORTHEASTERN UNITED STATES,
IEP, Inc., Worthington, OH.
For primary bibliographic entry see Field 5C.
W87-02468

HAZARDOUS WASTE SITE INVESTIGATIONS: VINYL CHLORIDE CONTAMINATION OF GROUNDWATER,
Suffolk County Dept. of Health Services, Hauppauge, NY.
For primary bibliographic entry see Field 5B.
W87-02469

RESPONSE TO GASOLINE CONTAMINATION OF RESIDENTIAL WATER WELLS - A CASE STUDY,
For primary bibliographic entry see Field 5G.
W87-02470

INVESTIGATION AND REMEDIATION OF A MINERAL SPIRIT PRODUCT LOSS IN A SHALLOW UNCONFINED AQUIFER,
O'Brien and Gere Engineers, Inc., Syracuse, NY.
For primary bibliographic entry see Field 5F.
W87-02472

EVALUATION OF CONTAMINATION BY ORGANICS AND HEAVY METALS IN A SOIL AND BEDROCK AQUIFER,
Goldberg-Zoino and Associates, Inc., Newton Upper Falls, MA.
For primary bibliographic entry see Field 5G.
W87-02473

MANAGING GROUND WATER SUPPLIES IN A SOLE SOURCE AQUIFER,
S E A Consultants, Inc., Boston, MA.
For primary bibliographic entry see Field 4B.
W87-02474

HYDROGEOLOGIC PLANNING FOR THE NESHAMINY CREEK BASIN, SOUTHEASTERN PENNSYLVANIA,
Neshaminy Water Resources Authority, Jamison, PA.
For primary bibliographic entry see Field 6A.
W87-02475

REMOVAL OF ORGANIC CONTAMINANTS FROM GROUNDWATER: STATUS OF EPA DRINKING WATER RESEARCH PROGRAM,
Environmental Protection Agency, Washington, DC. Office of Research and Development.
For primary bibliographic entry see Field 5F.
W87-02478

DISPOSAL OF REVERSE OSMOSIS WATER TREATMENT PLANT REJECT WATER BY INJECTION WELL: AN ASSESSMENT OF GEOCHEMICAL PLUGGING,
Missimer and Associates, Inc., Cape Coral, FL.
For primary bibliographic entry see Field 5E.
W87-02492

PROCEEDINGS OF THE FIFTH NATIONAL SYMPOSIUM AND EXPOSITION ON AQUIFER RESTORATION AND GROUND WATER MONITORING.
National Water Well Association, Worthington, OH.
Availabie from the National Water Well Association, 500 W. Wilson Bridge Rd., Worthington, OH. 43085. May 21-24, 1985, The Fawcett Center, Columbus, OH. 1985. 750 p.

Descriptors: *Conferences, *Aquifer management, *Groundwater quality, *Monitoring, Symposium, Aquifers, Groundwater movement, Water sampling, Water analysis, Hydrocarbons, Case studies, Wells.

The symposium covered a wide range of topics including physical containment methods, hydrodynamic control, pumping and treatment of contaminated groundwater, modeling in planning and evaluating remedial action, monitoring program/ system design, monitoring well design, groundwater sampling and analysis, monitoring investigations, monitoring and recovery of hydrocarbons in groundwater, and case histories. Government officials, consulting geologists, engineers and researchers, industry representatives and other interested persons met to learn and discuss state-of-the-art techniques employed in groundwater monitoring studies and aquifer cleanup projects. Additionally, the latest in state-of-the-art instrumentation and equipment was discussed and displayed. The symposium provided a forum for all who attended to communicate and share their experiences in the rapidly developing fields of aquifer restoration and groundwater monitoring. These proceedings are a compilation of papers presented by the symposium speakers. (See also W87-02498 thru W87-02542) (Author's abstract)
W87-02497

ASSISTANCE FOR RCRA PERMIT APPLICANTS,
Environmental Protection Agency, Chicago, IL. Region V.
For primary bibliographic entry see Field 5G.
W87-02498

RCRA PERMIT PROTOCOL FOR A CORRECTIVE ACTION PROGRAM,
Environmental Protection Agency, Washington, DC.
For primary bibliographic entry see Field 5G.
W87-02499

GROUND WATER MONITORING IN FLORIDA -- LIVING WITH HYDROLOGIC AND REGULATIVE PECULIARITIES,
Geraghty and Miller, Inc., Tampa, FL.
R. E. Moon.
IN: Proceedings of the Fifth National Symposium and Exposition on Aquifer Restoration and Ground Water Monitoring, May 21-24, 1985, The Fawcett Center, Columbus, Ohio. 1985. p 43-48.

Descriptors: *Groundwater quality, *Monitoring, *Florida, *Regulations, Aquifers, Potable, Groundwater pollution, Water quality control, Path of pollutants, Hydrologic aspects.

Florida has good reason to pursue and enforce legislation protecting groundwater, since much of the state is positioned directly above aquifers having the capacity to yield tremendous volumes of fresh potable water. In addition, large areas of the State's three principal aquifers (sand and gravel, Floridan, and Biscayne) have direct hydrologic connections with the land surface, so that contaminants disposed of at the surface can rapidly infiltrate downward to degrade the groundwater. Laws designed to protect these drinking-water sources have tended to place the major emphasis on sources of pollution, with far less consideration

given to variations in hydrologic conditions. Groundwater legislation is enforced by conditions written into groundwater permits and/or compliance orders. These documents describe, among other things, the required level of treatment for aquifer restoration projects, maximum distances of vertical and horizontal contaminant migration, groundwater standards, and groundwater classifications. These requirements may appear appropriate, but are often impractical where hydrologic anomalies are encountered. Florida's increasing population and its demand for fresh water presents a challenging case for groundwater protection. Many of the elements of a protection strategy can be demonstrated by considering relationships between regional industrial activities, hydrologic conditions, and groundwater monitoring requirements. (See also W87-02437) (Lantz-PTT)
W87-02500

POINT-IN-TIME COMPARISON; AN ALTERNATIVE TO THE STATISTICAL REQUIREMENTS OF RCRA ACCEPTED BY EPA,
For primary bibliographic entry see Field 5G.
W87-02501

GUIDELINES FOR MONITORING WELL INSTALLATION,
Wisconsin Dept. of Natural Resources, Madison.
For primary bibliographic entry see Field 7B.
W87-02505

CHANGES OF GROUND WATER QUALITY AROUND A WELL DURING ACID TREATMENT,
Krakow Technical Univ. (Poland). Faculty of Sanitary and Environmental Engineering.
For primary bibliographic entry see Field 5B.
W87-02506

GROUND WATER QUALITY ANOMALIES ENCOUNTERED DURING WELL CONSTRUCTION, SAMPLING, AND ANALYSIS IN THE ENVIRONS OF A HAZARDOUS WASTE MANAGEMENT FACILITY,
Woodward-Clyde Consultants, Walnut Creek, CA.
For primary bibliographic entry see Field 5B.
W87-02507

DESIGN AND INSTALLATION OF DEEP MULTILEVEL PIEZOMETER NESTS IN COLUMBIA RIVER BASALTS AT THE HANFORD SITE, WASHINGTON,
Atomics International Div., Richland, WA. Rockwell Hanford Operations.
For primary bibliographic entry see Field 7B.
W87-02508

MONITORING WELLS - CHICAGO TARP,
Metropolitan Sanitary District of Greater Chicago, IL.
B. Macaitis, and J. Sobanski.
IN: Proceedings of the Fifth National Symposium and Exposition on Aquifer Restoration and Ground Water Monitoring, May 21-24, 1985, The Fawcett Center, Columbus, Ohio. 1985. p 169-183, 8 fig.

Descriptors: *Monitoring wells, *Chicago, *Groundwater, Well function, Design standards, Design criteria, Construction, Hydraulic machinery, Values, Pumps, Electrical equipment.

The Metropolitan Sanitary District of Greater Chicago, in conjunction with the ongoing construction of its multi-billion dollar Tunnel and Reservoir Plant (TARP), has constructed several well systems to monitor groundwater conditions adjacent to those portions of the tunnel systems built to date. The reasoning behind the placement and type of wells associated with each tunnel subsystem, is discussed. Details are given, regarding the initial monitoring well design utilized, problems encountered with the initial wells, and modifications made to the design. It then elaborates on the revised design. The revised design rectified several of the initial design problems by: (1) elevating the sampling vault above-ground; (2) eliminating all electrical boxes from the interior of the vault; and (3) completely eliminating the check values from the discharge line and the pump, etc. (See also W87-02497) (Lantz-PTT)
W87-02509

FACTORS REQUIRING RESOLUTION IN INSTALLING VADOSE ZONE MONITORING SYSTEMS,
Woodward-Clyde Consultants, Santa Ana, CA.
For primary bibliographic entry see Field 7B.
W87-02510

GROUND WATER FLOW IN LIMESTONE TERRANES: STRATEGY RATIONALE AND PROCEDURE FOR RELIABLE, EFFICIENT MONITORING OF GROUND WATER QUALITY IN KARST AREAS,
National Park Service, Mammoth Cave, KY.
J. F. Quinlan, and R. O. Ewers.
IN: Proceedings of the Fifth National Symposium and Exposition on Aquifer Restoration and Ground Water Monitoring, May 21-24, 1985, The Fawcett Center, Columbus, Ohio. 1985. p 197-234, 12 fig, 100 ref.

Descriptors: *Groundwater movement, *Limestone, *Monitoring, *Groundwater quality, *Karst, Karst hydrology, Path of pollutants, Aquifers, Infiltration, Free water, Monitoring wells, Springs, Dye tracers.

Observation wells drilled to monitor pollutants in most limestone terrains are likely to miss detecting them, and to be a waste of time and money, because it is extremely improbable that such wells will intercept the conduits through which pollutants move. Groundwater flow and pollutant flow in most karst areas is not described by the radially dispersive characteristics of flow in granular or fractured media. Most flow in karst aquifers is turbulent, occurs in discrete conduits that are dendritic or trellised, is analogous to the flow of surface streams, and terminates in springs which have water quality representative of the mean of the groundwater basin. Surface streams are fed by infiltration water stored in interstream areas. Similarly, cave conduits are fed by diffuse Darcian flow through fine fractures. Flow is convergent in the upper and middle reaches of surface stream networks and cave conduit systems. In the lower reaches of both, however, flow is commonly divergent and in distributaries. Waste disposal sites should not be located in karst terrains. But if one is, the design of a groundwater monitoring network for a site in a maturely karsted area should include: (1) locating all springs, streams in sinkhole bottoms, and major streams in caves, (2) dye-tracing to establish connections between the disposal site, springs, and undergr.und streams, (3) monitoring of such connected points, (4) monitoring of at least one spring shown by dye-tracing not to be connected to the site, as a control, and (5) dyetracing to delineate groundwater basin boundaries. (See also W87-02497) (Lantz-PTT)
W87-02511

COMPARISON OF SAMPLING MECHANISMS AVAILABLE FOR SMALL-DIAMETER GROUND WATER MONITORING WELLS,
IEP, Inc., Worthington, OH.
For primary bibliographic entry see Field 7B.
W87-02512

SYSTEMATIC APPROACH FOR EVALUATING THE QUALITY OF GROUND WATER MONITORING DATA,
Kennedy/Jenks Engineers, San Francisco, CA.
For primary bibliographic entry see Field 7C.
W87-02513

USE OF CONDUCTIVITY PROFILES IN GROUND WATER QUALITY INTERPRETATION,
Jordan (Edward C.) Co., Inc., Portland, ME.
For primary bibliographic entry see Field 5G.
W87-02514

OPTIMAL HYDRAULIC CONTAINMENT OF CONTAMINATED GROUND WATER,
EMCON Associates, San Jose, CA.
For primary bibliographic entry see Field 5G.
W87-02516

GEOPHYSICAL DETECTION OF GRAVEL CHANNELS IN UNCONSOLIDATED SEDIMENTS,
NUS Corp., Pittsburgh, PA.
P. J. Jones, and M. W. Lucas.
IN: Proceedings of the Fifth National Symposium and Exposition on Aquifer Restoration and Ground Water Monitoring, May 21-24, 1985, The Fawcett Center, Columbus, Ohio. 1985. p 345-356, 6 fig, 1 ref.

Descriptors: *Geophysics, *Unconsolidated sediments, *Gravel, *Channels, Conductivity, Electromagnetic waves, Magnetic studies, Resistivity, Groundwater movement, Flow pattern, Clay, Sand, Gravel, Groundwater quality.

Electromagnetic conductivity and magnetometer surveys were performed to determine possible contaminant migration pathways and locations of buried metal at a hazardous waste disposal site on the east coast. Surveys were concentrated on site and southeast of the site, in the direction of presumed groundwater flow. Approximately 300 conductivity measurements were obtained with the instrument in different configurations, in order to prepare two resistivity maps of the site. Resistivity differences relate to inhomogeneities of the subsurface structure, and anomalously low resistivity readings may indicate a contaminant plume. Contours of the conductivity data show a resistivity high trending northeastward across the survey area. Magnetometer data show a magnetic low in this same area. These anomalies were thought to indicate an interbedded gravel deposit, such as those typical of coastal plain regions. A drilling program completed after the geophysical survey confirmed the presence of a buried gravel channel surrounded by sand and clay at the location of the anomaly. No significant amounts of contamination were noted. The resistivity high can therefore be associated with this gravel channel, rather than being indicative of a significant change in groundwater quality. The magnetic low is due to the different magnetic susceptibilities of clay, sand, and gravel. (See also W87-02497) (Author's abstract)
W87-02517

DEVELOPMENT OF A GROUND WATER MODEL UTILIZING THE INSTALLATION AND TESTING OF A VARIABLE DEPTH CLUSTER MONITORING WELL NETWORK,
Hess (R.K.R.) Associates, Stroudsburg, PA.
For primary bibliographic entry see Field 7A.
W87-02518

COMBINED EM RESISTIVITY AND FLUOROMETRY WITH DIRECT GROUNDWATER FLOW MEASUREMENT FOR LOCAL CHARACTERIZATION OF LANDFILL PLUMES,
K-V Associates, Inc., Falmouth, MA.
For primary bibliographic entry see Field 5B.
W87-02519

GRADIENT CONTROL FOR CONTAINMENT OF POLLUTANTS,
Geotechnical Engineers, Inc., Winchester, MA.
For primary bibliographic entry see Field 5G.
W87-02520

SUBSURFACE POLLUTION CONTAINMENT USING A COMPOSITE SYSTEM VERTICAL CUT-OFF BARRIER,
Wehran Engineering Corp., Middletown, NY.
For primary bibliographic entry see Field 8A.
W87-02521

EFFECTIVENESS OF A COMPACTED CLAY LINER IN PREVENTING GROUND WATER CONTAMINATION,

Science and Education Administration, University Park, PA. Northeast Watershed Research Center.
For primary bibliographic entry see Field 8G.
W87-02522

MITIGATION OF HYDROCARBON CONTAMINATION IN WATER SUPPLY AQUIFERS VIA MULTI RECOVERY WELL FOR HYDROLOGIC CONTROL,
Groundwater Technology, Inc., Concord, CA.
For primary bibliographic entry see Field 5G.
W87-02523

USE OF DIRECT-READING GROUNDWATER FLOWMETERS AND WATER LEVELS TO DETERMINE THE RECOVERY ZONE OF A PUMPING WELL,
K-V Associates, Inc., Falmouth, MA.
For primary bibliographic entry see Field 5G.
W87-02525

SUBSURFACE HYDROCARBON VAPORS: LOW LEVEL SAMPLING AND ANALYTICAL TECHNIQUES APPLICABLE TO THEIR IDENTIFICATION/MITIGATION,
Groundwater Technology, Inc., Chadds Ford, PA.
For primary bibliographic entry see Field 5B.
W87-02526

VACUUM: DEFENSE SYSTEM FOR GROUND WATER VOC CONTAMINATION,
Geotec, Caparra Heights, PR.
For primary bibliographic entry see Field 5G.
W87-02527

CONSIDERATIONS FOR THE CURRENT AND FUTURE PRACTICE OF BIORECLAMATION OF ORGANIC CONTAMINANTS/IMPORTANT ASPECTS OF FIELD APPLICABILITY IN GROUNDWATER RESTORATION,
Groundwater Technology, Inc., Chadds Ford, PA.
For primary bibliographic entry see Field 5G.
W87-02528

REMEDIATION STRATEGIES USING ENHANCED BIORECLAMATION,
FMC Corp., Princeton, NJ. Aquifer Remediation Systems.
For primary bibliographic entry see Field 5G.
W87-02529

RESTORATION OF WATER QUALITY IN A MULTIAQUIFER SYSTEM VIA INSITU BIODEGRADATION OF THE ORGANIC CONTAMINANTS,
Groundwater Technology, Inc., Chadds Ford, PA.
For primary bibliographic entry see Field 5G.
W87-02530

REMEDIATION OF A LEAKING UNDERGROUND STORAGE TANK WITH ENHANCED BIORECLAMATION,
Groundwater Technology, Inc., Chicago, IL.
For primary bibliographic entry see Field 5G.
W87-02531

UNSATURATED ZONE MONITORING AND RECOVERY OF UNDERGROUND CONTAMINATION,
Terra Vac, Inc., Dorado, PR.
For primary bibliographic entry see Field 5G.
W87-02532

IN SITU PHYSICAL/BIOLOGICAL TREATMENT OF METHYLENE CHLORIDE (DICHLOROMETHANE) CONTAMINATED GROUND WATER,
O.H. Materials Co., Findlay, OH.
For primary bibliographic entry see Field 5G.
W87-02534

RESPONSE TO AN ENVIRONMENTAL INCIDENT AFFECTING GROUND WATER,
O.H. Materials Co., Findlay, OH.
For primary bibliographic entry see Field 5G.
W87-02535

AQUIFER RESTORATION: CASE HISTORIES,
O.H. Materials Co., Findlay, OH.
For primary bibliographic entry see Field 5G.
W87-02536

PETROLEUM RECOVERY IN A TIDAL ENVIRONMENT,
Chevron USA, Inc., Concord, CA.
For primary bibliographic entry see Field 5G.
W87-02539

GROUND WATER CONTAMINATION FROM UNDERGROUND SOLVENT STORAGE TANKS, SANTA CLARA, CALIFORNIA,
Cooper Engineers, Inc., Richmond, CA.
For primary bibliographic entry see Field 5B.
W87-02540

EFFECTIVENESS OF HIGHWAY DRAINAGE SYSTEMS IN PREVENTING SALT CONTAMINATION OF GROUND WATER,
Massachusetts Dept. of Public Works, Wellesley Hills. Research and Materials Section.
For primary bibliographic entry see Field 4C.
W87-02541

DEVELOPMENT OF AN ADEQUATE RCRA GROUND WATER MONITORING SYSTEM IN FRACTURED SEDIMENTARY BEDROCK: A CASE STUDY,
West Virginia Dept. of Natural Resources, Charleston. Div. of Water Resources.
For primary bibliographic entry see Field 5G.
W87-02542

PILOT PLANT STUDIES OF TWO PROCESSES FOR OXIDATION OF AQUEOUS SULFIDE: PARADOX VALLEY UNIT, COLORADO RIVER BASIN SALINITY CONTROL PROJECT,
Bureau of Reclamation, Denver, CO. Engineering and Research Center.
For primary bibliographic entry see Field 5G.
W87-02549

2G. Water In Soils

EFFECT OF INCORPORATION OF CROP RESIDUES ON DEVELOPMENT OF DIAZOTROPHS AND PATTERNS OF ACETYLENE-REDUCING ACTIVITY IN NILE VALLEY SOILS,
Cairo Univ., Giza (Egypt). Faculty of Agriculture.
N. A. Hegazi, H. M. Khawas, R. S. Farag, and M. Monib.
Plant and Soil PLSOA2, Vol. 90, No. 1-3, p 383-389, 1986. 3 fig, 18 ref.

Descriptors: *Crop residues, *Soil organic matter, *Soil bacteria, *Diazotrophs, *Nitrogen fixation, Acetylene reduction, Wheat, Maize, Nitrogenase, Flood irrigation, Seasonal variation, Giza, Egypt, Nile River valley.

Acetylene-reducing activity and populations of diazotrophic bacteria were estimated simultaneously in Giza (Egypt) soils after harvest of wheat and maize crops. Amendment of soil with residues of either crop together with flood irrigation enhanced the development of diazotrophs and nitrogenase activities in the soil. Bacterial numbers and acetylene-reducing activity decreased as soils dried following flood irrigation. Activities decreased progressively with each cycle of irrigation following the original incorporation of organic matter. Nitrogenase activity in the soil was greater in the cooler winter than in summer. (Author's abstract)
W87-01774

EFFECT OF STRAW EXTRACT ON WATER ABSORPTION AND GERMINATION OF WHEAT (TRITICUM AESTIVUM L. VARIETY RR-21) SEEDS,
Govind Ballabh Pant Univ. of Agriculture and Technology, Pantnagar (India). Dept. of Soil Science.
For primary bibliographic entry see Field 3F.
W87-01779

EFFECT OF SULFUR-CONTAINING NITROGEN FERTILIZERS ON THE ELEMENTAL COMPOSITION OF CELERY (APIUM GRAVEOLENS) GROWN ON A POLLUTED MARSH SOIL,
Kiel Univ. (Germany, F.R.). Inst. fuer Pflanzenernaehrung und Bodenkunde.
For primary bibliographic entry see Field 3C.
W87-01781

APPLICABILITY OF THE GREEN AND AMPT INFILTRATION EQUATION TO RANGELANDS,
Utah State Univ., Logan. Watershed Science Unit.
M. Devaurs, and G. F. Gifford.
Water Resources Bulletin WARBAQ, Vol. 22, No. 1, p 19-27, February 1986. 6 fig, 4 tab, 17 ref. ARS Projects 749 and 771.

Descriptors: *Simulated rainfall, *Soil texture, *Infiltration, Equation parameters, Rangelands, Least squares method, Predictive triangles, Mathematical models.

The use of Green and Ampt infiltration equation parameters (determined by least squares fitting of field infiltration data or predicted from soil texture properties) to characterize infiltration on spatially varying rangeland sites was investigated. A least squares regression approach reduces the physically based parameters in the Green and Ampt to empirical coefficients since negative coefficients are obtained, particularly on plots with low infiltration rates. Green and Ampt parameters predicted from soil texture data describe infiltration rates less than 3 cm/hr. The applicability of these Green and Ampt parameters appears limited to sites with lower infiltration rates. Results indicate that soil texture predictive triangles, developed to describe infiltration on agricultural soils, need revision to adequately describe infiltration patterns on rangelands. (Author's abstract)
W87-01883

EMITTER SPACING AND GEOMETRY OF WETTED SOIL VOLUME,
Technion - Israel Inst. of Tech., Haifa. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 3F.
W87-01953

HIGH BASIN OF THE OUANNE: CONSEQUENCES OF TRANSFORMATIONS OF THE FARMLAND ON THE WATER STORAGE CAPACITY OF THE SOIL, (LE HAUT BASSIN DE L'OUANNE: CONSEQUENCES DES TRANSFORMATIONS DU PAYSAGE AGRAIRE SUR LA CAPACITE DE STOCKAGE DE L'EAU DANS LES SOLS),
For primary bibliographic entry see Field 4C.
W87-01971

TEMPERATURE DEPENDENCE OF SOIL HYDRAULIC PROPERTIES,
Auburn Univ., AL. Dept. of Agronomy and Soils.
J. W. Hopmans, and J. H. Dane.
Soil Science Society of America Journal SSSJD4, Vol. 50, No. 1, p 4-9, January-February 1986. 6 fig, 4 tab, 18 ref.

Descriptors: *Soil properties, *Temperature dependence, *Water retention curve, *Soil water, Surface temperature, Hydraulics, Permeability coefficient, Dual-energy gamma system, Viscosity, Pressure head, Prediction, Sandy loam.

A dual-energy gamma system was used to investigate temperature effects on the water retention curve and the hydraulic conductivity function of a

Norfolk sandy loam soil (Typic Paleudults). These hydraulic properties were determined from simultaneous measurements of soil water pressure head, volumetric water content, and soil temperature at 13 measurement points along a lucite flow cell during transient drainage conditions while maintaining a temperature gradient. It was concluded that temperature influences water retention more than can be explained by surface tension changes of pure water only. Entrapped air was not considered to be the primary cause of the larger temperature effect. The influence of temperature on measured hydraulic conductivities was close to predictions from viscosity changes for most of the measurement points. Deviations from predicted hydraulic conductivity values were attributed to thermal vapor flow. Temperature had little or no effect when hydraulic conductivity was plotted versus soil water pressure head. (Author's abstract)
W87-01981

SOIL HEAT FLUX, THERMAL CONDUCTIVITY, AND THE NULL-ALIGNMENT METHOD,
Commonwealth Scientific and Industrial Research Organization, Canberra (Australia). Div. of Environmental Mechanics.
D. A. DeVries, and J. R. Philip.
Soil Science Society of America Journal SSSJD4, Vol. 50, No. 1, p 12-18, January-February 1986. 1 fig, 3 tab, 19 ref, append.

Descriptors: *Soil heat flux, *Thermal conductivity, *Null-alignment method, *Null-point calorimetry, *Evaporation, Soil horizons, Prediction, Philip-De Vries theory, Mathematical models, Calculations.

Study of the energy balance of drying bare soils indicates that the major errors of null-point calorimetry are likely to arise from net evaporation in upper soil layers. A net evaporation rate of at least 1 mm/day probably occurred in the example used to indicate the null-alignment. This small evaporation rate changes the soil heat flux density (q) profile so radically that null-alignment may give thermal conductivity (lambda) values averaging about 52% of the correct ones. Diurnal variations of latent heat sink strengths, null-points, and temperature gradients, combine to produce diurnal variation of the error in null-aligned lambdas, thereby explaining the reported diurnal variation of null-aligned lambda. Since errors tend to be large and negative in the daytime, and small and positive at night, 24-hr averages are likely to be too small. Null-alignment does not provide the precise measures of q and lambda its exponents supposed, so that various null-alignment-based critiques of the Philip-De Vries theory of heat and moisture transfer in soils, and of the De Vries model of lambda, cannot be sustained. (Author's abstract)
W87-01982

TRANSPORT OF CADMIUM BY ORGANIC SOLVENTS THROUGH SOIL,
Arizona Univ., Tucson. Dept. of Soils, Water and Engineering.
For primary bibliographic entry see Field 5B.
W87-01983

SODICITY LEVELS OF SOILS EQUILIBRATED WITH WASTEWATERS,
Agricultural Research Organization, Bet-Dagan (Israel). Volcani Center.
For primary bibliographic entry see Field 5E.
W87-01984

TRANSFORMATIONS OF INORGANIC PHOSPHORUS DURING THE FLOODING AND DRAINING CYCLES OF SOIL,
California Univ., Davis. Dept. of Agronomy and Range Science.
R. N. Sah, and D. S. Mikkelsen.
Soil Science Society of America Journal SSSJD4, Vol. 50, No. 1, p 62-67, January-February 1986. 4 fig, 4 tab, 24 ref.

Descriptors: *Flooding, *Draining, *Inorganic phosphorus, *Aluminum, *Iron, *Calcium, *Soil chemistry, *Rice, Annual cycles, Clay.

The changes that occur among the inorganic P forms during flooding and after drainage in four soils were investigated. Significant changes in the inorganic P fractions aluminum-P (Al-P), iron-P (Fe-P), calcium-P (Ca-P), and reductant soluble-P (RS-P) occurred in soils during their flooding and draining cycles. Typically, the Fe-P fractions increased and Al-P fractions decreased when soils were flooded. The Ca-P fraction increased during flooding in two soils that had initially high levels of Ca-P, but was almost unchanged in two other soils with lower Ca-P content. The RS-P fraction decreased during flooding in the soils subjected to annual flooding for rice, whereas it increased in soils not subjected to annual flooding. During the drainage period, Fe-P and Al-P fractions decreased and RS-P fractions increased in flooded rice-cropped soils, probably due to occlusion of Fe-P and Al-P by hydrated Fe and Al oxides. The RS-P fraction in Willows clay, a soil that had not been flooded recently, decreased during the drainage period. P added as Ca(H2PO4)2.H2O was recovered mainly in the Fe-P and Al-P fractions. The recovery of Fe-P was greater in flooded-drained soils and Al-P was greater in unflooded soils. (Author's abstract)
W87-01985

DECOMPOSITION OF METHYL NITRITE IN SOLUTIONS AND SOILS,
Melbourne Univ., Parkville (Australia). School of Agriculture and Forestry.
For primary bibliographic entry see Field 5B.
W87-01986

AMMONIA VOLATILIZATION FROM NITROGEN SOURCES APPLIED TO RICE FIELDS: I. METHODOLOGY, AMMONIA FLUXES, AND NITROGEN-15 LOSS,
International Fertilizer Development Center, Muscle Shoals, AL.
For primary bibliographic entry see Field 5B.
W87-01987

AMMONIA VOLATILIZATION FROM NITROGEN SOURCES APPLIED TO RICE FIELDS: II. FLOODWATER PROPERTIES AND SUBMERGED PHOTOSYNTHETIC BIOMASS,
International Fertilizer Development Center, Muscle Shoals, AL.
For primary bibliographic entry see Field 5B.
W87-01988

AVAILABLE NITROGEN AND NITROGEN CYCLING IN FOREST SOILS EXPOSED TO SIMULATED ACID RAIN,
Cornell Univ., Ithaca, NY. Dept. of Agronomy.
For primary bibliographic entry see Field 5C.
W87-01990

EFFECT OF IRRIGATION METHOD AND ACETYLENE EXPOSURE ON FIELD DENITRIFICATION MEASUREMENTS,
Brigham Young Univ., Provo, UT. Dept. of Soil Microbiology.
R. E. Terry, E. N. Jellen, and D. P. Breakwell.
Soil Science Society of America Journal SSSJD4, Vol. 50, No. 1, p 115-120, January-February 1986. 4 fig, 4 tab, 35 ref.

Descriptors: *Denitrification, *Acetylene, *Nitrogen, *Sprinkler irrigation, *Flood irrigation, Soil atmosphere, Decomposition, Microorganisms, Metabolism.

This study attempted to: (1) observe the efects of sprinkle and flood irrigation on denitrification losses and (2) evaluate the effects of acetylene (C2H2) exposure on inhibition of nitrification and C2H2 decomposition. Acetylene was introduced into the soil atmosphere of field plots either by flood irrigation with C2H2-treated water or by continuous diffusion of C2H2 from dispersion tubes placed in the soil to a depth of 25 cm. Some plots received C2H2 through dispersion tubes continuously for 42 days, while rotated plots were treated for 7 days and then abandoned in favor of fresh plots. Denitrification losses from the fallow, clay loam soil were approximately 16 kg N/ha and 3 kg N/ha when the soil was sprinkle-irrigated (42-day totals). Soil microorganisms began to metabolize C2H2 after 7 days of continuous exposure. The problems of C2H2 decomposition and decreased C2H2 partial pressure were overcome by rotating field plots every 7 days. (Rochester-PTT)
W87-01991

SIMULTANEOUS DETERMINATION OF MOISTURE, ORGANIC CARBON, AND TOTAL NITROGEN BY NEAR INFRARED REFLECTANCE SPECTROPHOTOMETRY,
Queenaland Dept. of Primary Industries, Toowoomba (Australia). Wheat Research Inst.
For primary bibliographic entry see Field 7B.
W87-01992

COASTAL PLAIN SOILS OF SOUTHEASTERN NIGERIA: II. FORMS OF EXTRACTABLE IRON, ALUMINUM, AND PHOSPHORUS,
Michigan State Univ., East Lansing. Dept. of Crop and Soil Sciences.
G. Lekwa, and E. P. Whiteside.
Soil Science Society of America Journal SSSJD4, Vol. 50, No. 1, p 160-166, January-February 1986. 2 tab, 29 ref.

Descriptors: *Iron oxide, *Aluminum oxide, *Soil chemistry, *Coastal plain soils, *Nigeria, *Drainage, *Dithionite extraction, Inorganic phosphorus, Organic phosphorus, Ammonium oxalate extraction, Sand, Clay, Loam.

The distribution of citrate dithionite and ammonium-oxalate extractable Fe2O3 and Al2O3 were determined in nine Coastal Plain pedons of southeastern Nigeria. Distribution of available, organic, and active inorganic forms of P, plus the P fixation and available water holding capacities of these soils also were studied. The dithionite extractable Fe2O3 and Al2O3 generally increased with depth and clay content in each of the six loamy, well-drained pedons studied. The active Fe ratio usually decreased with depth, suggesting that higher proportions of Fe2O3 were generally present in more crystalline forms in the lower horizons of the well-drained soils. The active Al ratio usually increased with depth, but it was high throughout the poorly-drained, loamy aquic pedons. The well-drained aquic pedons contained larger amounts of Fe2O3 (dithionite) than Al2O3 (dithionite) and the active Fe ratios were higher. The loamy udic pedons and the loamy aquic pedons contained larger amounts of Al2O3 (dithionite) than Fe2O3 (dithionite). The sandy Aquod was very low in dithionite and oxalate Fe2O3 and Al2O3, except that the spodic horizon had maxima of dithionite and oxalate Fe2O3. The relative abundance of extractable inorganic P forms was generally in the order Fe-P > Al-P > Ca-P in the well-drained loamy pedons. Organic P in all the pedons was relatively high in the surface horizons. (Author's abstract)
W87-01993

PROPERTIES, CLASSIFICATION, AND INTERPRETATIONS OF MINESOILS AT TWO SITES IN WEST VIRGINIA,
West Virginia Univ., Morgantown. Div. of Plant and Soil Sciences.
N. C. Thurman, and J. C. Sencindiver.
Soil Science Society of America Journal SSSJD4, Vol. 50, No. 1, p 181-185, January-February 1986. 3 fig, 4 tab, 16 ref.

Descriptors: *Mine soil, *Soil taxonomy, *Soil classification, *Hydrogen ion concentration, *Particle size, *Soil reaction, *Lithology, Percolation, Acidity, Droughtiness, Topography, Slopes, Monongalia County, West Virginia.

Minesoils on two surface mines in Monongalia County, West Virginia, were classified using a proposed amendment to Soil Taxonomy. Minesoil properties and interpretations for selected nonagricultural uses were determined for both sites. The proposed amendment grouped minesoils into families based on differences in rock fragment lithology, soil reaction (pH), and particle size. The mine-

soils had a high rock fragment content (33-45%), high bulk density (1.55-1.86 Mg/cu m), low porosity (26-38%), low water retention capacity (0.07-0.12 kg/kg), moderately-slow estimated hydraulic conductivity (0.1-1 micron/sec), and irregular distribution of organic C with depth, and low pH (4.1-5.1). Soil factors affecting the nonagricultural use of the mine sites were slow percolation, stoniness, acidity, and droughtiness. Site factors (slope, irregular topography, size of the site, and the presence of highwalls and steep outslopes) were more limiting to development than soil factors. Classification using the proposed amendment to Soil Taxonomy aided in separating minesoils according to differences in management-related properties and could be useful for general planning. (Author's abstract)
W87-01994

DERIVATION OF LAND QUALITIES TO ASSESS ENVIRONMENTAL PROBLEMS FROM SOIL SURVEYS,
Stichting voor Bodemkartering, Wageningen (Netherlands). Dept. of Soil Chemistry.
For primary bibliographic entry see Field 7C.
W87-01995

EARTHWORMS AS A FACTOR IN THE REDUCTION OF SOIL CRUSTING,
National Soil Erosion Lab., West Lafayette, IN.
For primary bibliographic entry see Field 3F.
W87-01996

FACTORS AFFECTING THE STABILITY OF SOIL CRUSTS IN SUBSEQUENT STORMS,
Agricultural Research Organization, Bet-Dagan (Israel).
For primary bibliographic entry see Field 3F.
W87-01997

PHYSICAL AND CHEMICAL PROPERTIES OF A HAPLOXEROLL AFTER FIFTY YEARS OF RESIDUE MANAGEMENT,
Agricultural Research Service, Pendleton, OR. Columbia Plateau Conservation Research Center.
For primary bibliographic entry see Field 3F.
W87-01999

FIELD MEASUREMENT OF DENITRIFICATION IN IRRIGATED SOILS,
Brigham Young Univ., Provo, UT. Dept. of Agronomy and Horticulture.
S. L. Hallmark, and R. E. Terry.
Soil Science SOSCAK, Vol. 140, No. 1, p 35-44, July 1985. 6 fig, 5 tab, 29 ref.

Descriptors: *Denitrification, *Irrigation, *Soil atmosphere, *Nitrogen, *Fertilizers, *Acetylene inhibition technique, Ammonium sulfate, Potassium nitrate, Soil chemistry, Spring wheat, Nitrous oxide reduction.

Two methods for introducing C2H2 to the soil atmosphere for denitrification measurement by the C2H2 inhibition technique were compared and the effects of N fertilizer source and cropping on denitrification losses were observed. In June and July 1981, C2H2 dissolved in water was used to irrigate fallow plots left unfertilized or fertilized with (NH4)2SO4 or KNO3 at 200 kg N/ha. Total denitrification losses of 10.1, 19.7, and 18.7 kg N/ha were measured from unfertilized plots and plots fertilized with (NH4)2SO4 and KNO3, respectively, with 3.70 kg N2O-N/ha emitted from fertilized plots receiving no C2H2. In summer 1982, denitrification losses from cropped soils irrigated with C2H2-treated water were compared with those from soils that received C2H2 through dispersion tubes in the soil. The denitrification loss from plots cropped to spring wheat was 0.22 kg N/ha during the 4-wk study when C2H2 was supplied through dispersion tubes, whereas during the same period 0.30 kg N/ha was lost from cropped plants irrigated with C2H2-treated water. Both dispersion tubes and irrigation water should be used to provide adequate C2H2 partial pressures in the soil atmosphere for inhibition of N2O reduction throughout the irrigation cycle. (Author's abstract)
W87-02001

CHARACTERISTICS AND GENESIS OF SOME SOILS IN THE SOUTHERN FOOTHILLS OF CENTRAL ALBORZ, IRAN,
Utah State Univ., Logan. Dept. of Soil Science and Biometeorology.
F. Rooyani, and A. R. Southard.
Soil Science SOSCAK, Vol. 140, No. 1, p 45-54, July 1985. 5 fig, 4 tab, 20 ref.

Descriptors: *Soil genesis, *Landforms, *Iran, *Hezardareh formation, Organic carbon, Jajerud River, Latyan Reservoir, Slopes, Precipitation, runoff, Weathering, Erosion, Soil classification, Central Alborz.

Five soils representing the major landforms on part of the watershed of the Jajerud River and Latyan Reservoir, Iran, were examined. The soils occur on the Hezardareh formation, a poorly-cemented conglomerate and volcanic ash. All the soils are calcareous and nonsaline, with a pH range of 7.5-8.1. Organic carbon decreases regularly with depth, even in the soils on the stream terrace positions, indicating that, if these soils underwent flooding in the past, evidence of cyclic accumulations of organic carbon has been obliterated. The soils on steep slope gradients (>10%) are classified as Torriorthents and Calciorthids. The soils on nearly level slopes (<2%) are classifed as Xerochrepts because of mottling, cambic horizons and more effective precipitation due to less runoff, possible runin, and less removal of weathering products by erosion. Genesis and classification of these soils are discussed. (Rochester-PTT)
W87-02002

ESTIMATING AVAILABLE WATER-HOLDING CAPACITY OF WESTERN NIGERIAN SOILS FROM SOIL TEXTURE AND BULK DENSITY, USING CORE AND SIEVED SAMPLES,
Ife Univ. (Nigeria).
P. O. Aina, and S. P. Periaswamy.
Soil Science SOSCAK, Vol. 140, No. 1, p 55-58, July 1985. 2 tab, 9 ref.

Descriptors: *Soil texture, *Bulk density, *Soil samples, *Soil water capacity, Sieves, Nigeria, Cores, Prediction, Water retention, Silt, Clay, Particle size, Regression equations, Standard errors, Statistics, Soil physical properties.

Using core and sieved soil at -1/3 and -15 bar matric potentials, water retention was determined on a number of western Nigerian soils and related by predictive equations to soil textural separates and bulk density (BD). Soils were from forested and cultivated croplands over 12 sites selected in the sedimentary and basement complex regions to give a representative range of soil textures and bulk densities. Water retention and -1/3 bar by core was estimated by functions of sand and BD with a minimum standard error (SE) of 1.7% and for sieved soil by functions of silt and clay (SE 1.36%). Clay content alone predicts the -15 bar water (SE 0.70%, r squared = 0.93). Available water-storage capacity (AWSC), expressed on a gravimetric basis by the core method, can be predicted with a SE of 1.54% by the regression equation AWSC = 14.01 + 0.03 (silt x clay) - 8.78 (BD), with r squared of 0.83. This is related to the sieved soil AWSC as follows: AWSC sub core = 14.04 + 1.07(AWSC sub sieved) - 9.46(BD) + 0.14(sand). (Author's abstract)
W87-02003

PHOSPHATE MOVEMENT IN COLUMNS OF SANDY SOIL FROM A WASTEWATER-IRRIGATED SITE,
Florida Univ., Gainesville. Dept. of Soil Science.
For primary bibliographic entry see Field 5E.
W87-02004

NEW CONCEPT FOR RECLAIMING SODIC SOILS WITH HIGH-SALT WATER,
Thessaloniki Univ., Salonika (Greece). School of Agriculture.
For primary bibliographic entry see Field 3C.
W87-02005

EFFECT OF SOIL SUBMERGENCE ON UREA HYDROLYSIS,
International Fertilizer Development Center, Muscle Shoals, AL. Fertilizer Technology Div.
N. K. Savant, A. F. James, and G. H. McClellan.
Soil Science SOSCAK, Vol. 140, No. 2, p 81-88, August 1985. 4 fig, 5 tab, 23 ref.

Descriptors: *Urea hydrolysis, *Soil water, *Flooding, *Algae, *Iron oxides, *Urease, Soil chemistry, Wetland rice soils, Oxidation-reduction potential, Oxygen.

The effect of soil submergence on urea hydrolysis was evaluated in laboratory experiments in which time in the floodwater, the oxidized soil, and the reduced soil were considered. In a submerged soil system with about 1 mm of floodwater and incubated for <24 hr, the depletion of O2 seemed to retard the hydrolysis. With a longer submergence time, soil Eh decreased, and soil urease activity also decreased to a nearly stable value. On reoxidation of the reduced soil under a continuous 1 cm of floodwater, however, the soil urease activity increased markedly. In general, the order of the urea hydrolysis in the main three components of the wetland soil system was oxidized soil > reduced soil > floodwater (without algae). The presence of algae increased urease activity in the floodwater. The iron oxides (FeO-Fe2O3, Fe2O3, and alpha-FeOOH), which may be present in the floodwater and the underlying oxidized layer, did not seem to influence urease activity. These results show that urease activity will show temporal and spatial variations in wetland rice soils. (Rochester-PTT)
W87-02006

DISSOLUTION RATE OF GYPSUM IN AQUEOUS SALT SOLUTIONS,
Texas A and M Univ., El Paso. Agricultural Research and Extension Center.
For primary bibliographic entry see Field 3C.
W87-02007

SPATIAL VARIABILITY OF SOIL WATER TENSION IN AN IRRIGATED SOIL,
New Mexico State Univ., Las Cruces. Dept. of Crop and Soil Sciences.
M. H. Saddiq, P. J. Wierenga, J. M. H. Hendrickx, and M. Y. Hussain.
Soil Science SOSCAK, Vol. 140, No. 2, p 126-132, August 1985. 6 fig, 1 tab, 29 ref.

Descriptors: *Soil water, *Tensiometers, *Trickle irrigation, *Flooding, *Rain, *Spatial variability, Chile pepper, Leaf area index.

Ninety-nine tensiometers were installed along a 76-m row planted with chile peppers and irrigated through trickle tubing placed 5 cm below the soil surface, with measurements of soil water tension obtained after the plants had achieved a leaf area index >3. Readings were taken after the row was irrigated through the trickle line, after rainfall, and at the end of the season after surface flooding of the row from both sides. Extensive spatial variability and little spatial dependence (distance of dependence always <6 cm) was seen in soil water tension measured along the row. Variability and spatial dependence were a function of the method of water application, time after water application, and the magnitude of the soil water tension. Variability was greatest and spatial dependence smallest for water application through a trickle line. Variability was the least and spatial dependence the greatest after rain or extensive flooding. (Author's abstract)
W87-02009

COMPUTER SIMULATIONS OF THE TRANSPORT OF PESTICIDES WITH NONUNIFORM WATER FLOW IN GREENHOUSE SOIL,
Institute for Pesticide Research, Wageningin (Netherlands).
For primary bibliographic entry see Field 5B.
W87-02011

COMPARISON OF THE UNSATURATED HYDRAULIC CONDUCTIVITIES OF CALCAREOUS AND NONCALCAREOUS SOILS,
Texas Tech Univ., Lubbock. Dept. of Plant and Soil Science.
D. Nkalai, and R. E. Zartman.
Soil Science SOSCAK, Vol. 140, No. 3, p 179-183, September 1985. 3 fig, 3 tab, 11 ref.

Descriptors: *Calcareous soils, *Hydraulic conductivity, *Unsaturated flow, *Noncalcareous soils, *Permeability coefficient, *Infiltration, *Soil water, Soil horizons, Estacado series, Friona series, Soil water release curves, Depth.

Hydraulic properties of adjoining calcareous and noncalcareous soils were compared in the field; soils were the calcareous Estacado series (fine loamy, mixed, thermic, Calciorthidic Paleustoll) and the noncalcareous Friona series (fine loamy, mixed, thermic Petrocalcic Paleustoll). In situ, unsaturated hydraulic conductivities were determined in the Ap1, Ap2, Bt1, and Bt2 horizons of each soil. Water was ponded daily and allowed to infiltrate under falling head conditions. Water additions were terminated when the tensiometers in the Bt2 horizons indicated no change of the soil water potential from the previous day. Hydraulic conductivities were calculated using in situ change of soil water contents and soil water potentials with time, the soils being covered to prevent evaporation. The noncalcareous soil had higher hydraulic conductivities than the calcareous soil of the same water content. The calcareous Ap1 and Ap2 horizons had higher hydraulic condutivities than the noncalcareous soil at the same water potential. In situ soil water release curves indicated that the calcareous soil retained more water than the noncalcareous soil at the same soil water potential in the paired horizons. Unsaturated hydraulic conductivities increased with depth of both soils. (Rochester-PTT)
W87-02012

PREDICTION OF HYDRAULIC CONDUCTIVITY FROM SOIL WATER RETENTION DATA,
Commonwealth Scientific and Industrial Research Organization, Canberra (Australia). Div. of Forest Research.
T. Talsma.
Soil Science SOSCAK, Vol. 140, No. 3, p 184-188, Septemebr 1985. 3 fig, 1 tab, 23 ref.

Descriptors: *Soil water, *Hydraulic conductivity, *Soil moisture retention, *Permeability coefficient, *Mathematical models, *Sandy loam, *Clay, Soil physical properties.

Simple relationships are reported among soil water content, theta, soil water potential, psi, and hydraulic conductivity, K, tested on five uniform soil materials, for which the necessary parameters were obtained in the laboratory, and on nine field soils, where the parameters were obtained in situ. Agreement between experimental K(theta) relationships and those calculated from saturated hydraulic conductivity and the water retention curve psi(theta) was good for four laboratory soils, but was only adequate in the high water content range for a fine sand. For the field soils, agreement was good for four soils, adequate in the higher water content range for two, and inadequate for three soils in the sandy loam to light clay range. (Author's abstract)
W87-02013

APPLICATON OF ATMOSPHERIC NEUTRONS TO SOIL MOISTURE MEASUREMENT,
Yamanashi Medical Coll., (Japan). Dept. of Physics.
For primary bibliographic entry see Field 7B.
W87-02014

MOVEMENT OF SURFACE AND DEEP-PLACED PHOSPHORUS IN A SANDY LOAM SOIL IN RELATION TO INITIAL SOIL WETNESS, AMOUNT OF WATER APPLIED, AND EVAPORATION POTENTIALS,
Indian Agricultural Research Inst., New Delhi. Div. of Agricultural Physics.
P. K. Sharma, A. K. Sinha, and T. N. Chaudhary.
Soil Science SOSCAK, Vol. 140, No. 4, p 256-263, October 1985. 9 fig, 1 tab, 15 ref.

Descriptors: *Soil water movement, *Phosphorus, *Evaporation, *Sandy loam, *Irrigation, *Leaching, Isotope studies, Subsoil, Soil horizons, Transport.

Laboratory studies were conducted on the effect of initial soil water content and amount of water applied on the movement of surface- (0-2 cm) and deep-placed (8-10 cm) P, under potential evaporation (PE) rates of 2.2-7.5 mm/day in a sandy loam (Typic Ustochrept) soil. P was applied as diammonium hydrogen orthophosphate at a rate of 300 ppm, labeled with 10 microcuries 32P/g P. Initial soil wetness affected P displacement by affecting the time needed to leach the soil. P mobility increased with amount of water applied, but the P front lagged behind the water front. Increasing rates of evaporation did not affect the total depth of P penetration, but did affect the distribution of P in the displaced zone. P peaks shifted upward, and their number increased from one, under no evaporation, to two under evaporation conditions. The effect of PE was more pronounced on displacement of surface-placed P than on deep-placed P; even under higher PE, deep-placed P was better distributed in subsoil than surface-placed P, which showed a tendency to accumulate in the surface soil layers. (Author's abstract)
W87-02015

IN SITU MEASUREMENT OF FIELD-SATURATED HYDRAULIC CONDUCTIVITY, SORPTIVITY, AND THE ALPHA-PARAMETER USING THE GUELPH PERMEAMETER,
Guelph Univ. (Ontario). Dept. of Land Resource Science.
For primary bibliographic entry see Field 7B.
W87-02016

STATIC AND DYNAMIC THREE-DIMENSIONAL STUDIES OF WATER IN SOIL USING COMPUTED TOMOGRAPHIC SCANNING,
EMBRAPA-UEPAE, Sao Carlos (Brazil).
For primary bibliographic entry see Field 7B.
W87-02017

EFFECT OF SIMULATED ACID RAIN ON NITRATE AND AMMONIUM PRODUCTION IN SOILS FROM THREE ECOSYSTEMS OF CAMELS HUMP MOUNTAIN, VERMONT,
Vermont Univ., Burlington. Dept. of Plant and Soil Science.
For primary bibliographic entry see Field 5C.
W87-02018

MODEL EVALUATIONS OF THE IMPACT OF PERTURBED WEATHER CONDITIONS ON SOIL-RELATED CHARACTERISTICS,
Hebrew Univ. of Jerusalem (Israel). Seagram Centre for Soil and Water Sciences.
Y. Mahrer, and M. Segal.
Soil Science SOSCAK, Vol. 140, No. 5, p 368-375, November 1985. 8 fig, 2 tab, 24 ref. NSF Grant ATM 8414181, NOAA Grant NA81RAH00001.

Descriptors: *Numerical models, *Evaporation, *Soil-weather relationships, *Soil atmosphere, *Weather patterns, *Israel, *Soil temperature, Cloud cover, Equations, Long-wave radiation, Vapor pressure deficit, Mathematical models, Perturbations.

An interactive atmosphere-soil numerical model was employed to evaluate the impact of perturbed weather conditions on the diurnal patterns of soil moisture, soil temperature, and surface layer fluxes. Common weather perturbations occurring during the spring in Israel were modelled, including cloudiness, passage of a warm front, and passage of a cold front. The soil temperature patterns generally showed peak values for the surface temperature around noon and later in the afternoon for the perturbations patterns. A time lag in the downward penetration of the thermal effect was evident in all simulated cases. Cloudiness, which reduced incoming solar radiation by 50%, produced the most significant perturbation of soil temperature, thus reflecting the dominance of the solar radiation component in the interface heat balance equation. Passage of fronts involved two effects: (1) modifying the exchange of heat between the soil and the atmosphere through sensible heat fluxes and (2) modifying the long-wave radiation at the soil surface. Patterns of soil wetness, evaporation fluxes, and the air vapor pressure deficit were significantly affected by changes in the weather. (Rochester-PTT)
W87-02019

SOIL SALINITY AS AFFECTED BY HIGH-SULFATE WATER,
Agricultural Research Inst., Nicosia (Cyprus).
For primary bibliographic entry see Field 3C.
W87-02020

DISSOLUTION OF GYPSUM IN ALKALI SOILS,
Central Soil Salinity Research Inst., Karnal (India).
For primary bibliographic entry see Field 3C.
W87-02021

INSPECTIONAL ANALYSIS IN THE THEORY OF WATER FLOW THROUGH UNSATURATED SOIL,
California Univ., Riverside. Dept. of Soil and Environmental Sciences.
G. Sposito, and W. A. Jury.
Soil Science Society of America Journal SSSJD4, Vol. 49, No. 4, p 791-798, July-August 1985. 29 ref. Electric Power Research Institute Contract Project RP2485-6.

Descriptors: *Soil water movement, *Mathematical analysis, *Soil water, *Unsaturated soil, Mathematical equations, Flow discharge, Richards equation, Scaling theory, Similitude analysis, Hydraulic conductivity, Soil water potential, Diffusivity.

Conventional inspectional analysis was applied to the one-dimensional Richards equation to provide a unified classification scheme for three microscopic scaling approaches which have been used to describe soil water flow phenomena under laboratory or field conditions. Scaling parameters and similarity groups developed in an inspectional analysis of the Richards equation, depended upon the boundary and initial conditions imposed as well as on the special physical hypotheses invoked. Nielsen similarity analysis was based on a zero-flux boundary condition and the assumption that the hydraulic conductivity, soil water diffusivity, and matric potential were exponentional functions of water content. Warrick similarity analysis was formulated independently of the boundary and initial conditions while adopting three scaling parameters to define reduced forms of the water content, hydraulic conductivity, and matric potential. Two of these parameters are often correlated. Macroscopic Miller similarity analysis was based on the physical postulate that water transport through unsaturated soil was governed by viscous flow and capillary forces. It differed from the classical Miller similar media concept in which it required a scaling parameter for the volumetric water content, and makes no direct reference to the geometrical structure of a soil at the pore scale. (Author's abstract)
W87-02022

ANALYSIS OF SOIL WATER CONTENT AND TEMPERATURE USING STATE-SPACE APPROACH,
California Univ., Davis. Dept. of Land, Air and Water Resources.
F. Morkoc, J. W. Biggar, D. R. Nielsen, and D. E. Rolston.
Soil Science Society of America Journal SSSJD4, Vol. 49, No. 4, p 798-803, July-August 1985. 10 fig, 1 tab, 22 ref.

Descriptors: *Soil water, *Temperature, *State-space approach, *Data acquisitions, Estimaties,

Mathematical equations, Mathematical analysis, Irrigation, Mathematical models, Statistical analysis.

The autoregressive moving average statistical method require that the observations manifest stationarity, meaning that the expected value of the observations is constant over the domain considered, but can also be used to estimate missing observations. However, the state-space model can be used for smoothing or estimating and forecasting a relatively short, nonstationary series of observations. A first order state-space model was used here to estimate the missing observations of 0- to 5-cm gravimetric soil water content. Joint analysis of observed water content and soil surface temperatures from a sorghum field irrigated by two line source irrigation system were used. The parameters of the model indicated the degree of spatial correlation between the two measured parameters. The expectation maximization algorithm, and Kalman smoothed estimators were used to estimate the first order state-space model parameters by maximum likelihood. (Khumbatta-PTT)
W87-02023

COMPARISON OF LIQUID RETENTION CURVES WITH POLAR AND NONPOLAR LIQUIDS,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Agronomy.
R. J. Lenhard, and R. H. Brooks.
Soil Science Society of America Journal SSSJD4, Vol. 49, No. 4, p 816-821, July-August 1985. 10 fig, 1 tab, 32 ref.

Descriptors: *Liquid retention, *Soil chemistry, Minerals, Adsorption, Clays, Soil-water potential, Capillarity, Hydraulic properties.

Capillary pressure-saturation data obtained on unconsolidated porous media containing different clay minerals with different liquids, were compared to evaluate the effect of clay-water interactions on liquid-retention characteristics. The clay minerals used were kaolinite, illite and a Ca-montmorillonite. The wetting fluids were distilled water and a light hydrocarbon, soltrol. The hydraulic variables, capillary pressure and saturation, were transformed to account for differences in contact angle, density, and surface tension of the liquids. The liquid-retention functions obtained for the different wetting fluids for the kaolinite samples were statistically similar, while those obtained for montmorillonite and illite were different. The difference was because the montmorillonite samples swelled up with water. The difference for the illite samples could be accounted for by an immobile water layer. (Author's abstract)
W87-02024

TEMPORAL STABILITY OF SPATIALLY MEASURED SOIL WATER PROBABILITY DENSITY FUNCTION,
Centre National de la Recherche Scientifique, Grenoble (France). Inst. de Mecanique de Grenoble.
G. Vachaud, A. Passerat Silans, P. Balabanis, and M. Vauclin.
Soil Science Society of America Journal SSSJD4, Vol. 49, No. 4, p 822-828, July-August 1985. 7 fig, 2 tab, 10 ref.

Descriptors: *Soil water, *Temporal distribution, *Probability density function, *Spatial distribution, Time series analysis, Statistical analysis, Soil texture, Mathematical studies, Stability analysis, Measuring instruments, Moisture meters, Data acquisition, Data interpretation.

Soil water data collected from three different fields were analyzed by two techniques (temporal analysis on the differance between individual and spatial average values and Spearman's rank correlation) to search if time-invariant characteristic statistical properties of the probability density functions can be assigned to individual locations. A grass field was equipped with neutron access tubes and surveyed 24 times during a 2 1/2 year period while another field with olive trees was subjected to quarterly measurements for two consecutive years. The latter field cropped in wheat was gravimetrically sampled on a regular spatial pattern five different times, and was routinely surveyed during a 1 year period at four selected locations, using a neutron moisture meter. A very significant time-stability of particular individual locations characterized by the same parameter in the statistical distribution of the observations taken over the field was shown by the data. Some locations conserve the property to represent the mean and extreme values of the field content at any time along the year. This stability is explained by relationships between soil texture and water content. (Khumbatta-PTT)
W87-02025

STEADY ABSORPTION FROM SPHEROIDAL CAVITIES,
Commonwealth Scientific and Industrial Research Organization, Canberra (Australia). Div. of Environmental Mechanics.
J. R. Philip.
Soil Science Society of America Journal SSSJD4, Vol. 49, No. 4, p 828-830, July-August 1985. 2 fig, 6 ref.

Descriptors: *Soil water movement, *Spheroidal cavities, *Infiltration, *Adsorption, *Soil water, Unsaturated flow, Saturation, Subirrigation, Mathematical models, Flow rates.

There is a growing interest in the effect of the shape of the surface of a cavity on the infiltration rate. Appropriate solutions for various cavity geometries, as well as giving results for steady absorption will yield the leading term of the expansion sought (for small and moderate dimensionless cavity lengths) for the steady infiltration rate from such cavities. An important family of cavity shapes is provided by spheroids with two semiaxes of length a and the third of length of b. Considered here are the full gamut of shapes, from the case b/a tends to infinity (the needle), through the range of prolate spheroids (b/a $>$ 1), to the sphere (b/a=1), to the range of oblate spheroids (b/a $<$ 1) and the case b/a tends to 0 (the disc). Exact solutions are given for steady adsorption from prolate and oblate spheroidal cavities (or bulbs of saturation). The solutions for the needle, sphere and disc are special cases. Apart from their direct relevance to systems with negligible gravity, the results yield the leading terms of expansions describing steady infiltration for small and moderate values of the dimensionless cavity (or bulb) length. (Khumbatta-PTT)
W87-02026

PHYSICAL AND MINERALOGICAL DATA TO DETERMINE SOIL HYDRAULIC PROPERTIES,
Auburn Univ., AL. Dept. of Soil Science.
W.E. Puckett, J. H. Dane, and B. F. Hajek.
Soil Science Society of America Journal SSSJD4, Vol. 49, No. 4, p 831-836, July-August 1985. 3 fig, 4 tab, 27 ref.

Descriptors: *Soil properties, *Hydraulic properties, *Ultisol, *Mineralogy, Permeability, Fluid mechanics, Soil water potential, Hydraulic conductivity, Porosity, Surface area, Particle size, Statistical analysis, Regression analysis, Mathematical studies.

Physical, mineralogical and soil hydraulic properties of Ultisols developed in unconsolidated sediments of the Lower Coastal Plain were studied. Soil water retention curves, saturated hydraulic conductivity, bulk density, quantitative mineralogy, surface area, and particle size distribution were determined by horizon for seven pedons. Relationships among them were analyzed by regression analysis. Fine sand, sand and clay percentages were highly correlated with saturated hydraulic conductivity, surface area and volumetric water contents at specific pressure heads. Correlation coefficients $>$0.95 were obtained for regression equations estimating soil water retention curves from particle size data. These relationships can be used for a quick characterization of soil hydraulic properties from particle size distribution data. No significant correlations were found between soil hydraulic and mineralogical properties of the clay fraction. (Author's abstract)
W87-02027

SIGNIFICANCE OF GROUND FREEZING ON SOIL BULK DENSITY UNDER ZERO TILLAGE,
Guelph Univ. (Ontario). Dept. of Land Resource Science.
B. D. Kay, C. D. Grant, and P. H. Groenevelt.
Soil Science Society of America Journal SSSJD4, Vol. 49, No. 4, p 973-978, July-August 1985. 9 fig, 13 ref.

Descriptors: *Frost, *Ground freezing, *Zero tillage, *Soil water, *Bulk density, Ice lenses, Freeze-thaw, Soil compaction, Pores, Soil porosity, Ground ice.

In Ontario, soil bulk densities were persistently higher in soils on which zero tillage was practiced, than in soils which were conventionally tilled, in spite of the fact that the formation of ice lenses in winter on soils which are frost susceptible may produce porosity sufficiently large to cause displacements of the ground surface of several centimeters. Studies were carried out on two different soils over two winters on which different tillage treatments were practiced, to explain the anomalous behavior. Soils under zero tillage accumulated more snow over winter and did not freeze as deeply as soils that were plowed in the fall, resulting in a greater surface displacement on the fall plowed soil. Soils under both tillage treatments quickly consolidated prior to spring planting. The formation of ice lenses tended to create inherently unstable pores which collapsed as the ice melted and the soils drained. The unstable nature of pores created by ice lenses appeared to be in contrast to the characteristics of pores created by tillage which were more stable because of their formation by the vertical and horizontal displacements of peds. (Author's abstract)
W87-02028

EFFECTS OF SUBSOILING AND IRRIGATION ON CORN PRODUCTION,
North Carolina State Univ. at Raleigh. Dept. of Soil Science.
D. K. Cassel, and E. C. Edwards.
Soil Science Society of America Journal SSSJD4, Vol. 49, No. 4, p 996-1001, July-August 1985. 4 fig, 7 tab, 16 ref. USDA-ARS Agreement No. 58-7B30-9-77.

Descriptors: *Subsoiling, *Irrigation, *Corn, *Crop production, Tensiometers, Agricultural hydrology, Soil management, Tillage pans, Root length.

Deep tillage and irrigation are two soil management techniques that have been used separately to alleviate water shortages for crops growing on soils having root restricting tillage pans. The purpose of this study was to evaluate the effects of in-row-subsoiling (s), irrigation (I), and in-row-subsoiling plus irrigation on corn (Zea mays L.) production on Wagram soils, having a dense tillage pan. Main plot treatments were CD (Conventional tillage, dryland), CI (Conventional tillage, irrigated when soil water pressure (SWP) at the 0.25-m depth reached -40 kPa), SD (in-row-subsoiled and bedded, dryland), and SI (in-row-subsoiled and bedded, irrigation when SWP $<$ -40 kPa at 0.30-m depth). Total growing season precipitation in 1979 was near normal; 1980 and 1981 were both drought years. The CI, SD, and SI treatments always had significantly higher yields of grain and stover, and lower numbers of barren plants compared to treatment CD. Maximum corn height was greatest (2.68 m) for treatment SI and leaf area indices for treatments CI, SD, and SI were 23, 28, and 36% greater, respectively, than the 2.56 value for CD. Mean grain yields for treatments CI, SD, and SI were 215, 197, and 277% greater, respectively than the 2.58 mg/ha CD yield. Apparent irrigation water use efficiencies were 0.031 and 0.014 mg/ha/mm for treatments CI and SI, respectively. Estimates of subsoil water utilization using neutron attenuation and tensionmeter data were 50 mm/yr, which resulted in an apparent subsoil water use effeciency of 0.10 mg/ha/mm. (Author's abstract)

W87-02029

DEPTH OF SURFACE SOIL-RUNOFF INTERACTION AS AFFECTED BY RAINFALL, SOIL SLOPE, AND MANAGEMENT,
Agricultural Research Service, Durant, OK. Water Quality and Watershed Research Lab.
For primary bibliographic entry see Field 2J.
W87-02031

SPATIAL VARIABILITY OF FIELD-MEASURED SOIL-WATER CHARACTERISTICS,
Eidgenoessische Technische Hochschule, Zurich (Switzerland).
P. J. Greminger, Y. K. Sud, and D. R. Nielsen.
Soil Science Society of America Journal SSSJD4, Vol 49, No. 5, p 1075-1082, September-October 1985. 13 fig, 7 tab, 19 ref.

Descriptors: *Soil physics, *Spatial variability, *Soil water, *Geohydrology, Statistical analysis, Van Genuchten Model, Graphical analysis, Loan, Probability distribution, Sand, Topsoil.

One hundred neutron access pipes were placed 1 m apart along a 100 m transect together with tensiometers located at soil depths of 0.3 and 0.6 m. After ponding the experimental site with water for at least 4 d, the site was allowed to be drained and covered with 0.3 m of straw to reduce evaporation. Measurements of soil-water content (theta) and soil-water pressure head (h) initially made at 2-h intervals, were made less frequently as redistribution proceeded. The mean soil water characteristic curve for the 100 m transect of Yolo loam described by the van Genuchten model provided estimates of theta within + or - 0.04 cu m/cu m for h > -36,000 Pa when values of (theta, h) from all 100 sites were composted. When values of theta and h measured within a horizontal distance of 1 m were used for each of the 100 sites, the van Genuchten model provided estimates of theta for a given value of h within the limitations of measurement by the neutron moisture meter method. Spatial crosscorrelation coefficients between theta and h during redistribution, manifested significant values for distances of 10 m or less. It appears that improved estimates of theta (h) across a field of Yolo loam can be achieved using geostatistical methods for lags 10 m. Because autocorrelation lengths of theta(t) and h(t) at a particular soil depth were found to depend upon the internal drainage properties of the entire soil profile, a maximum distance between pairs of like observations could not be established for improving estimates of theta or h. Crosscorrelations between theta for a given value of h and percentage of sand proved useful for identifying the variations in the soil water characteristics curves measured at the 0.3 m soil depth, and of little value for the 0.6 m depth. Their utility is based upon the fact that small differences in percentage of sand in the topsoil yield significant differences between theta(h)-curves. The practical significance of this research was that it addressed the impact of the separation distance between a tensiometer and a neutron meter access tube on the precision of the measured soilwater characteristic curve. Greater precision was obtained for separation distances less than 10 m. (Lantz-PTT)
W87-02032

EVALUATION OF THE HOT AIR METHOD FOR MEASURING SOIL WATER DIFFUSIVITY,
Amsterdam Univ. (Netherlands). Dept. of Soil Science and Geology.
J. J. M. Van Grinsven, C. Dirksen, and W. Bouten.
Soil Science Society of America Journal SSSJD4, Vol. 49, No. 5, p 1093-1099, September-October 1985. 6 fig, 5 tab, 13 ref.

Descriptors: *Soil water diffusivity, *Soil water movement, *Hot air method, *Soil water, *Diffusivity, Simulation, Hydraulic conductivity, Desorption, Thermal water flow, Vapor flow, Evaporation.

The Hot Air Method (HAM) is said to be a fairly new and simple method of measuring soil water diffusivity. With the introduction of temperatures much higher than originally proposed, the validity of the underlying assumptions must be questioned. Philip's iterative solution was adapted for desorption out of a semi-infinite column at constant surface water content, to evaluate the effects of soil type and boundary water contents on the experimental results. Errors due to deviations from assumed isothermal conditions were evaluated for the large temperature increases that occur in soil columns during execution of HAM. Evaporation losses and water redistribution during sampling of the soil column were evaluated by simulation. With the present usage of air temperatures up to 250 degree C, and sampling times of several minutes, HAM did not satisfy the prerequisite assumptions. Reports of favorable results from HAM were probably due to mutual compensation of different errors and to considerable smoothing of experimental results. In spite of its great experimental advantages, one should be dissuaded from using HAM unless the experimental errors are minimized and the calculation technique made objective and reproducible. This paper however, proposes some improvements for the experimental procedures. (Author's abstract)
W87-02033

ESTIMATING SOIL WATER CHARACTERISTICS FROM SIMPLER PROPERTIES OR LIMITED DATA,
Agricultural Research Service, Durant, OK. Water Quality and Watershed Research Lab.
L. R. Ahuja, J. W. Naney, and R. D. Williams.
Soil Science Society of America Journal SSSJD4, Vol. 49, No. 5, p 1100-1105, September-October 1985. 4 fig, 6 tab, 15 ref.

Descriptors: *Soil water, *Data interpretation, *Statistical methods, Statistical analysis, Soil water potential, Spatial distribution, Watersheds, Hydrologic models.

Broad-based regression equations were investigated for estimation of the spatially variable soil water content-matric potential relationships in a 1.6-ha watershed, from the textural and structural properties of soil. A simple log-log line based on two known values and estimates obtained from one known value for each relationship and a complete relationship for one case using the similar-media scaling concept were examined. The results were compared with measurements on 189 soil cores from different sites and horizons. In general, the soil water contents calculated at different matric potentials were larger than the measured values. The mean relative error ranged from 8% to 29% with the standard deviation of errors ranging from 17% to 36%. The model which incorporated two measured soil water contents as additional variables reduced the errors in calculated values considerably. A simple log-log line drawn through the two known points gave nearly the same accuracy. The estimates from the method of scaling were better than those from the model based on textural and structural variables alone. (Khumbatta-PTT)
W87-02034

MODEL FOR THE SOIL SOLUTION COMPOSITION OF AN OASIS,
Holwon Univ., Alexandria (Egypt).
A. M. Elprince.
Soil Science Society of America Journal SSSJD4, Vo. 49, No. 5, p 1121-1128, September-October 1985. 8 fig, 3 tab, 29 ref.

Descriptors: *Oasis, *Soil solution, *Hydrologic models, *Al-Hassa, *Saudi Arabia, *Chemical precipitation, *Soil properties, Salinity, Gypsum, Computer models, Mathematical studies, Chemical analysis, Sodium, Chlorine, Magnesium sulfate, Bicarbonates.

A static computer model based on the evaporative concentration of irrigation waters has been developed for the origin of soil solution compositions in the Al-Hassa oasis, Saudi Arabia. The model predicted the precipitation of calcite and the conversion of smectite to attapulgite when in equilibrium with atmospheric CO2 pressure. Precipitation of gypsum when irrigation water was concentrated by a factor of 3.7, and the precipitation of silica gel when the water was concentrated by a factor of 7.5 were also predictable. The model may be applicable to other oases in arid environments. Mineral fractionation follows a natural slope within the oasis, as indicated by the isoconcentration lines for salinity, carbonates, and gypsum in oasis soils. Six primary processes were considered responsible for the formation of soil solutions from irrigation water under oasis conditions. The processes are deaquation due to transpiration and evaporation, precipitation and dissolution of soil mineral phases, K fixation, Na and Cl retention, MgSO4(0) formation, and biological formation of HCO3. Agricultural production of dates was absent in areas where the electrolytic conductivity of 1:5 soil solution extracts exceeded 6 dS/m (i.e., in gypsum and silica gel precipitation areas). (Khumbatta-PTT)
W87-02035

HIGH HUMIDITY-INDUCED INCREASE IN WATER REPELLENCY IN SOME SANDY SOILS,
Florida Univ., Gainesville. Dept. of Agronomy.
G. W. Jex, B. H. Bleakley, D. H. Hubbell, and L. L. Munro.
Soil Science Society of America Journal SSSJD4, Vol. 49, No. 5, p 1177-1182, September-October 1985. 5 fig, 6 tab, 13 ref.

Descriptors: *Sand, *Water, *Humidity, Soil water, Electron microscopy, Antibiotics, Actinomycetes, Relative humidity, Soil bacteria, Gamma radiation.

The degree of resistance to water penetration of diverse water repellent soils was found to be controlled by their moisture states. Repellency was found to increase sharply when samples were incubated at 100% relative humidity and to decline when wetted or when incubated at humidities < 90%. A nonwater-repellent soil in the field did not become repellent after incubation at 100% humidity. A Florida soil was used for detailed studies. Repellency increase in this sand was temperature dependent and could be eliminated by gamma irradiation. Application of antibiotics prior to incubation suggested that prokaryotic organisms were essential to repellency increase. A dilution study of the St.Lucie soil incubated at 100% relative humidity for various periods revealed that the actinomycete population correlated best with the repellency increase. When incubated, St. Lucie sand was investigated by electron microscopy, and actinomycetes were found to dominate the visual field. A model for repellency increase and decline based on soil humidity was offered. (Author's abstract)
W87-02036

USE OF SOIL SURVEY DATA FOR REGIONAL SOIL WATER SIMULATION MODELS,
Stichting voor Bodemkartering, Wageningen (Netherlands). Dept. of Applied Soil Physics.
J. H. M. Wosten, J. Bouma, and G. H. Stoffelsen.
Soil Science Society of America Journal SSSJD4, Vol. 49, No. 5, p 1238-1244, September-October 1985. 5 fig, 4 tab, 23 ref.

Descriptors: *Soil surveys, *Simulation analysis, *Model studies, *Soil water, Water regime, Evapotranspiration, Soil horizons, Hydraulic conductivity, Soil profiles, Soil water potential.

A detailed soil survey of an area of 650 ha was used to obtain basic soil physical data for a simulation model of the water regime in the unsaturated zone. Nine major soil horizons were defined on the basis of pedological classification, and other easily measurable characteristics like texture, structure, organic matter content, and bulk density. Multiple measurements of hydraulic conductivity and moisture retention curves were made, yielding average curves. Only five of the nine major soil horizons were different from a soil physics point of view. Representative soils for the mapping units were transformed into soils composed of a characteristic sequence of some of these five horizons. A simulation map was thus created from the soil map, which contained 41 delineated areas as compared to 110 delineations on the soil map. Sixty independ-

est test borings indicated 80 + or - 6% purity comparing borings, and the legend of the simulation map. A simulation run for one pedon with the simulation model SWATRE, showed excellent agreement between measured and calculated evapotranspiration for the years 1976, 1977 and 1978. (Author's abstract)
W87-02037

FACTORS AFFECTING OXIDATION-REDUCTION PROCESSES IN AN OXISOL WITH A SEASONAL WATER TABLE,
North Carolina State Univ. at Raleigh. Dept. of Soil Science.
For primary bibliographic entry see Field 2K.
W87-02038

TILLAGE EFFECTS ON SOIL WATER RETENTION AND PORE SIZE DISTRIBUTION OF TWO MOLLISOLS,
Maryland Univ., College Park. Dept. of Agronomy.
For primary bibliographic entry see Field 4C.
W87-02040

THEORY, CONSTRUCTION, AND OPERATION OF SIMPLE TENSIOMETERS,
For primary bibliographic entry see Field 7B.
W87-02058

NITRATE LEACHING THROUGH SANDY SOIL AS AFFECTED BY SPRINKLER IRRIGATION MANAGEMENT,
Nebraska Univ., North Platte. Dept. of Agronomy.
For primary bibliographic entry see Field 3F.
W87-02092

PHOSPHORUS SOLUBILITY IN SLUDGE-AMENDED CALCAREOUS SOILS,
New Mexico State Univ., Las Cruces. Dept. of Crop and Soil Sciences.
For primary bibliographic entry see Field 5E.
W87-02098

SULFUR AND CARBON ISOTOPES AS TRACERS OF SALT-MARSH ORGANIC MATTER FLOW,
Marine Biological Lab., Woods Hole, MA. Ecosystems Center.
B. J. Peterson, R. W. Howarth, and R. H. Garritt.
Ecology ECOLAR, Vol. 67, No. 4, p 865-874, August 1986. 7 fig, 2 tab, 30 ref. NSF Grant No. DEB 81-04701.

Descriptors: *Sulfur isotopes, *Tracers, *Carbon isotopes, *Isotopic tracers, *Organic matter, *Salt marshes, Cape Cod, Spartina, Food chains, Sulfur bacteria, Sulfides, Sulfates, Phytoplankton, Assimilative capacity, Detritus, Plankton.

Sulfur and carbon isotopes were used to trace flows of organic matter from producers to consumers in the Great Sippewissett Salt Marsh on Cape Cod. Spartina alterniflora and sulfur oxidizing bacteria assimilated isotopically light sulfides which were detected in consumers. Phytoplankton and upland plants assimilated isotopically heavier sulfates with little or no fractionation. A dual isotope approach showed that mud snail and killifish depend heavily on Spartina detritus while filter feeders such as oysters and ribbed mussels depend on a mixture of plankton and Spartina detritus. These were both shown to be more important organic matter sources for marsh macroconsumers than either sulfur-oxidizing bacteria or organic matter derived from terrestrial inputs. (Author's abstract)
W87-02099

PREPARATION OF UNSMEARED SOIL SURFACES AND AN IMPROVED APPARATUS FOR INFILTRATION MEASUREMENTS,
Sydney Univ. (Australia). Dept. of Soil Science.
A. J. Koppi, and H. R. Geering.
Journal of Soil Science, Vol. 37, No. 2, p 177-181, June 1986. 1 fig, 3 tab, 7 ref.

Descriptors: *Infiltration rate, *Measuring instruments, *Epoxy resins, *Soil surfaces, *Soil sealants, *Surface sealing, Subsoil.

A quick setting epoxy resin can be used to prepare a soil surface for infiltration measurements. Experiments using alluvial prairie soil and red podzolic soil showed more rapid entry of water with resin treatment when compared with conventionally treated soil surfaces. Longer infiltration rates appear to more closely reflect field structural conditions. A subsoil infiltration apparatus with a water reservoir remote from the hole that measures constant head infiltration through a specially prepared auger hole is also described. (Michael-PTT)
W87-02118

MODEL FOR PARTICLE-SELECTIVE TRANSPORT OF TRACERS IN SEDIMENTS WITH CONVEYOR BELT DEPOSIT FEEDERS,
National Oceanic and Atmospheric Administration, Ann Arbor, MI. Great Lakes Environmental Research Lab.
For primary bibliographic entry see Field 2H.
W87-02124

EFFECT OF IRRIGATION ON SOIL OXYGEN STATUS AND ROOT AND SHOOT GROWTH OF WHEAT IN A CLAY SOIL,
Commonwealth Scientific and Industrial Research Organization, Griffith (Australia).
W. S. Meyer, H. D. Barrs, R. C. G. Smith, N. S. White, and A. D. Heritage.
Australian Journal of Agricultural Research AJAEA9, Vol. 36, No. 2, p 171-185, 1985. 5 fig, 3 tab, 30 ref, 2 append.

Descriptors: *Irrigation, *Flooding, *Soil oxygen, *Clay loam, *Wheat, *Plant growth, *Lysimeters, *Sampling, Root development, Soil aeration, Soil texture, Nitrogen, Crop yield, Soil drainage, Root zone.

Two watering treatments (flood and control) were applied to undisturbed and repacked cylinders of Marah clay loam housed in a lysimeter facility. Wheat was grown in the cylinders and soil was kept either well watered with frequently applied small amounts or subjected to three separate periods of inundation (flood treatment). Greater pore space and better drainage of the repacked soil ensured that its average soil oxygen level was three times that of undisturbed soil, but inundation rapidly decreased soil oxygen in both samples. Root growth slowed when oxygen levels were 15% less than those occurring in dry aerated soil, and ceased when soil oxygen was less than 10% of the maximum after a 48-hour inundation period. Leaf and stem growth were not particularly sensitive to root zone conditions which may have been due to the advanced stage of plant growth when treatments were applied and to low nitrogen status. The data indicate that if soil oxygen levels decrease as a result of flooding, wheat root growth will stop and grain yield will decrease. Improved aeration of fine-textured soils is only possible if internal drainage is improved and prolonged inundations avoided. Appendices contain separate articles on a lysimeter facility for root zone studies and methods for obtaining undisturbed soil cores. (Author's abstract)
W87-02141

MODELING THE EFFECTS OF ACID DEPOSITION: ESTIMATION OF LONG-TERM WATER QUALITY RESPONSES IN A SMALL FORESTED CATCHMENT,
Virginia Univ., Charlottesville. Dept. of Environmental Sciences.
For primary bibliographic entry see Field 5C.
W87-02271

MELTWATER MOVEMENT IN NATURAL HETEROGENEOUS SNOW COVERS,
National Hydrology Research Inst., Ottawa (Ontario).
For primary bibliographic entry see Field 2C.
W87-02284

STEADY TWO- AND THREE-DIMENSIONAL FLOWS IN UNSATURATED SOIL: THE SCATTERING ANALOG,
Melbourne Univ., Parkville (Australia). Dept. of Mathematics.
R. T. Waechter, and J. R. Philip.
Water Resources Research WRERAQ, Vol. 21, No. 12, p 1875-1887, December 1985. 9 fig, 2 tab, 37 ref.

Descriptors: *Unsaturated soils, *Unsaturated flow, *Soil water movement, *Steady flow, Porosity, Statistical methods, Mathematical equations, Mathematical models, Scattering, Infiltration, Hydrologic models, Hydrologic properties, Flow characteristics, Fluid mechanics.

A first exposition of the analog between steady flow in unsaturated soils and porous media and plane pulse scattering is presented. Steady infiltration from circular cylindrical and spherical cavities is described. Asymptotic methods prove accurate and results replace and explain previous semi-empirical estimates of the limiting behavior of flows. One particular result is that the depth of the effectively wetted region for the cylinder is 128 times the depth for the sphere, thus confirming and supplementing previous studies. A byproduct of this study is the correction of a long-standing, classical result in scattering theory. The prospect for extending these methods to flows in other geometries, heterogeneous soils and generally to linear convection-diffusion processes is also discussed. (Michael-PTT)
W87-02303

SCATTERING FUNCTIONS AND INFILTRATION,
Commonwealth Scientific and Industrial Research Organization, Canberra (Australia). Div. of Environmental Mechanics.
J. R. Philip.
Water Resources Research WRERAQ, Vol. 21, No. 12, p 1889-1894, December 1985. 23 ref.

Descriptors: *Scattering, *Infiltration, *Saturated flow, *Unsaturated flow, *Groundwater movement, *Soil water movement, Hydrologic models, Hydrologic properties, Mathematical equations, Flow characteristics, Steady flow, Saturated soils, Boundary conditions, Soil water, Wetting, Fluid mechanics.

Van de Hulst theorems give simple connections between the forward scattering function and the total extinction cross section in the theory of scattering plane harmonic waves by an obstacle. Analagous theorems are proved for two- and three-dimensional steady flows in saturated soils from finite cavities of arbitrary size and shape and with arbitrary boundary conditions on the cavity surface. These theorems connect 'downward wetting functions' and total cavity flow rates. Relations between scattering functions in the wave context and wetting functions in the soil water context are established. Flow rates for a large range of cavity shapes can be inferred from extant results on forward scattering functions. It is proved that at large dimensionless radius, flow is concentrated at a small angular region vertically beneath the cavity and has a Gaussian distribution with angular standard deviation. (Michael-PTT)
W87-02304

'PHYSICS' OF SOIL WATER PHYSICS,
California Univ., Riverside. Dept. of Soil and Environmental Sciences.
G. Sposito.
Water Resources Research WRERAO, Vol. 22, No. 9, p 83S-88S, August 1986. 38 ref. NSF Grant CEE-79-20778.

Descriptors: *Soil water, *Soil physics, *Mathematical analysis, Mathematical equations, Algorithms, Richards Equation, Flow profiles, Heat transfer.

Some aspects of the underlying conceptualizations (as opposed to experimental methodologies or mathematical algorithms) in soil water physics are

reviewed. Contemporary issues relating to the symmetry properties of the Richards Equation, the status of the energy picture of soil water, and the theoretical description of coupled heat and water flows in soil are raised to exemplify as yet unresolved problems in the 'physics' of soil water physics. Four basic questions which formalize these problems are posed as suggestions for future research. These questions discuss: (1) the possible groups of similarity transformations of the Richards Equation and how they may be used to classify the behavior of water in soils; (2) what is the most general form of the law of internal energy balance for soil water which is consistent with the Richards Equation; (3) defining the heating flux density vector which can lead to a predictive model of coupled heat and water flow in soil that is both self-consistent and experimentally testable; and (4) how the microscopic or the molecular behavior of water in soil can lead to macroscopic transport equations and to the observed values of macroscopic transport coefficients. (Lantz-PTT)
W87-02318

WATER FLOW AND SOLUTE TRANSPORT PROCESSES IN THE UNSATURATED ZONE,
California Univ., Davis. Dept. of Land, Air and Water Resources.
D. R. Nielsen, M. T. van Genuchten, and J. W. Biggar.
Water Resources Research WRERAO, Vol. 22, No. 9, p 89S-108S, August 1986. 17 fig, 254 ref.

Descriptors: *Unsaturated flow, *Soil water movement, *Solute transport, *Aeration zone, Chemical properties, Physical properties, Microbiological studies, Vadose zone, Research needs, Groundwater movement, Groundwater, Flow discharge, Mathematical models.

Reviewed is the current conceptual understanding of the basic processes of water flow and chemical transport in the unsaturated (vadose) zone, and of various deterministic mathematical models that are being used to describe these processes. During the past few decades, a tremendous effort has been directed toward unravelling the complexities of various interactive physical, chemical, and microbiological mechanisms affecting unsaturated flow and transport. Unfortunately, segmented, disciplinary research has contributed to a lack of experimental and theoretical understanding of the vadose zone, which, in turn, has precluded the accurate prediction and management of flow and contaminant transport through it. Thus a more unified and interdisciplinary approach is needed that considers the most pertinent physical, chemical, and biological processes operative in the unsaturated zone. Challenges for both fundamental and applied researchers to reveal the intricacies of the zone and to integrate these with currently known concepts are numerous, as is the urgency for progress inasmuch as our soil and groundwater resources are increasingly subjected to the dangers of long-term pollution. Specific research areas in need of future investigation are outlined. (Author's abstract)
W87-02319

DEGRADATION OF CIS- AND TRANS-PERMETHRIN IN FLOODED SOIL,
Maryland Univ., College Park. Dept. of Botany.
For primary bibliographic entry see Field 5B.
W87-02372

EMPIRICAL FUNCTION TO DESCRIBE MEASURED WATER DISTRIBUTIONS FROM HORIZONTAL INFILTRATION EXPERIMENTS,
Iowa State Univ., Ames. Dept. of Agronomy.
J. F. McBride, and R. Horton.
Water Resources Research WRERAQ, Vol. 21, No. 10, p 1539-1544, October 1985. 5 fig, 2 tab, 20 ref.

Descriptors: *Infiltration, *Soil water movement, *Mathematical analysis, *Horizontal flow, *Soil water, Regression analysis, Least squares method, Soil textures, Soil saturation, Diffusivity, Mathematical equations.

Introduced is a function that can be used to describe soil water distribution curves produced from horizontal infiltration experiments. The function's flexibility enables it to fit (by linear least squares regression) water distribution data for a wide range of soil textures. The function is easy to differentiate and to integrate. The proposed rapid, simple method compares favorably with previous methods, and yields calculated values of D(theta) (where D = soil water diffusivity, and theta = water content), that reach expected large values near saturation. This is a clear advantage over other available simple methods of determining D(theta) from horizontal infiltration, where it is assumed that soil water diffusivity is exponentially related to water content. Accordingly, they describe D(theta) adequately in the midrange of water contents but miss the important values near saturation. THe use of scaled axes, the other application of the method presented, offers a quick and easy procedure to obtain values of D(theta). This approach reduces calculations to a minimum. (Lantz-PTT)
W87-02383

REMEDIATION STRATEGIES USING ENHANCED BIORECLAMATION,
FMC Corp., Princeton, NJ. Aquifer Remediation Systems.
For primary bibliographic entry see Field 5G.
W87-02529

SOIL DESTRUCTION AND SOIL POLLUTION,
For primary bibliographic entry see Field 5B.
W87-02557

2H. Lakes

SHIFTS IN THE INTRACELLULAR ATP POOLS OF IMMOBILISED NOSTOC CELLS (CYANOBACTERIA) INDUCED BY WATER STRESS,
Florida State Univ., Tallahassee. Dept. of Biological Science.
M. Potts, and N. S. Morrison.
Plant and Soil PLSOA2, Vol. 90, No. 1-3, p 211-221, 1986. 8 fig, 22 ref. NSF Grant PCM-8203709.

Descriptors: *Adenosine triphosphate, *Cyanophyta, *Water stress, *Photophosphorylation, *Electron transport, *Oxidative phosphorylation, Sodium azide, Carbonyl cyanide m-chlorophenylhydrazone, Water potentials, Plant physiology, Nitrogenase, Chloramphenicol.

Rewetting of immobilized, desiccated cells of Nostoc commune UTEX 584 induced an increase in ATP pool size at the expense of photophosphorylation or electron transport (oxidative) phosphorylation. The rise in the ATP pool size was instantaneous and was shown to be due to ATP synthesis. This increase did not occur when cells were rewetted in the presence of 10 millimole/liter sodium azide, whereas a partial inhibition was observed with 2 micromole/liter carbonyl cyanide m-chlorophenylhydrazone. For cells dried at more extreme water potentials, the lag of about 48 hr observed before the ATP pool reached control values was of similar duration to that observed in the recovery of nitrogenase upon rewetting. Chloramphenicol (10 micromole/liter) stimulated significantly the upshift in the size of the ATP pool of Nostoc cells upon rewetting, yet inhibited completely the rise in nitrogenase activity. (Author's abstract)
W87-01771

INFLUENCE OF CYANOBACTERIAL HYPERSCUM ON HETEROTROPHIC ACTIVITY OF PLANKTONIC BACTERIA IN A HYPERTROPHIC LAKE,
National Inst. for Water Research, Pretoria (South Africa).
For primary bibliographic entry see Field 5C.
W87-01786

COMPARISON OF ACRIDINE ORANGE, ACRIFLAVINE, AND BISBENZIMIDE STAINS FOR ENUMERATION OF BACTERIA IN CLEAR AND HUMIC WATERS,
Helsinki Univ. (Finland). Dept. of General Microbiology.
For primary bibliographic entry see Field 5A.
W87-01788

RESPONSES OF ISONYCHIA BICOLOR TO ALKALINE PH: AN EVALUATION OF SURVIVAL, OXYGEN CONSUMPTION, AND CHLORIDE CELL ULTRASTRUCTURE,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Biology.
For primary bibliographic entry see Field 5C.
W87-01789

RELATIONSHIP OF CRAYFISH (ORCONECTES VIRILIS) GROWTH TO POPULATION ABUNDANCE AND SYSTEM PRODUCTIVITY IN SMALL OLIGOTROPHIC LAKES IN THE EXPERIMENTAL LAKES AREA, NORTHWESTERN ONTARIO,
Department of Fisheries and Oceans, Winnipeg (Manitoba). Freshwater Inst.
R. L. France.
Canadian Journal of Fisheries and Aquatic Sciences CJFSBX, Vol. 42, No. 6, p 1096-1102, June 1985. 2 fig, 3 tab, 47 ref.

Descriptors: *Crayfish, *Growth, *Populations, *Oligotrophic lakes, *Primary productivity, *Phytoplankton, Egg production, Experimental Lakes Area, Ontario, Canada, Chlorophyll a, Reproduction.

Crayfish growth in four lakes in the Experimental Lakes Area (ELA, northwestern Ontario) was examined by analysis of size-frequency distributions, molt increment data, and calculation of instantaneous growth and mean size at onset of sexual maturity. Oronectes virilis growth rates at ELA were only 27-38% of those reported for other areas. Growth varied both among study lakes and between years. Higher temperatures and a longer growing season during 1980 increased growth an average of 12% over that of the preceding year. Crayfish growth and maximum size in four to six lakes were significantly correlated with phytoplankton production and chlorophyll a concentration. Growth regulated both the number of age I animals attaining sexual maturity and the per capita egg production, and was also directly related to the proportion of mature females that were fertilized. The author believes that population regulation is mediated through alterations in reproductive capacity, which is correlated with system productivity. (Author's abstract)
W87-01790

CHEMISTRY OF LAKE HOVVATN, NORWAY, FOLLOWING LIMING AND REACIDIFICATION,
Norsk Inst. for Vannforskning, Oslo.
For primary bibliographic entry see Field 5B.
W87-01791

INFLUENCE OF FISH-ZOOPLANKTON-PHYTOPLANKTON INTERACTIONS ON THE RESULTS OF SELENIUM TOXICITY EXPERIMENTS WITHIN LARGE ENCLOSURES,
Department of Fisheries and Oceans, Winnipeg (Manitoba). Freshwater Inst.
For primary bibliographic entry see Field 5C.
W87-01792

ORGANIC NITROGEN COMPOUNDS IN ATMOSPHERIC PRECIPITATION: THEIR CHEMISTRY AND AVAILABILITY TO PHYTOPLANKTON,
Department of Scientific and Industrial Research, Taupo (New Zealand). Div. of Marine and Freshwater Sciences.
For primary bibliographic entry see Field 5B.
W87-01793

EXCESS UNSUPPORTED 210PB IN LAKE SEDIMENT FROM ROCKY MOUNTAIN LAKES: A GROUNDWATER EFFECT,
Maine Univ. at Orono. Dept. of Geological Sciences.
S. A. Norton, C. T. Hess, G. M. Blake, M. L. Morrison, and J. Baron.
Canadian Journal of Fisheries and Aquatic Sciences CJFSBX, Vol. 42, No. 7, p 1249-1254, July 1985. 2 fig, 4 tab, 23 ref. Man and the Biosphere Grant Rm-81-206-GR.

Descriptors: *Isotope studies, *Radon-222, *Lead-210, *Lake sediments, *Oligotrophic lakes, *Groundwater, Rocky Mountain National Park, Colorado, Lake Louise, Radium-226, Sediment cores.

Sediment cores from four high-altitude (approximately 3,200 m) lakes in Rocky Mountain National Park, Colorado, were dated by 210Pb chronology. Background (supported) 210Pb activities of the four cores ranged from 0.26 to 0.93 Beq/g dry weight, high for typical oligotrophic lakes. Integrated unsupported 210pb ranged from 0.81 (a typical value for most lakes) to 11.0 Beq/sq cm. The 210Pb activity in the surface sediments ranged from 1.48 to 22.2 Beq/g dry weight. Sediment from Lake Louise, the most unusual of the four, had 22.2 Beq/g dry weight at the sediment surface, and integrated unsupported 210Pb = 11.0 Beq/sq cm, and supported 210Pb = 0.74 Beq/g dry weight. 226Ra content of the sediment is insufficient to explain either the high unsupported 210Pb or the 222Rn content of the water column of Lake Louise, which averaged 96.2 Beq/l. The authors concluded that 222Rn-rich groundwater entering the lake is the source of the high 222Rn in the water column. This, in turn is capable of supporting the unusually high 210Pb flux to the sediment surface. Groundwater with high 222Rn may control the 210Pb budget of lakes where sediment cores have integrated unsupported 210Pb greater than 2 Beq/sq cm. (Author's abstract)
W87-01796

EVIDENCE OF CONTAMINANT LOADING TO LAKE ONTARIO FROM THE NIAGARA RIVER,
National Water Research Inst., Burlington (Ontario). Aquatic Physics and Systems Div.
For primary bibliographic entry see Field 5B.
W87-01798

NUTRIENT DYNAMICS IN A LITTORAL SEDIMENT COLONIZED BY THE SUBMERSED MACROPHYTE MYRIOPHYLLUM SPICATUM,
Institut National de la Recherche Scientifique, Sainte-Foy (Quebec).
R. Carignan.
Canadian Journal of Fisheries and Aquatic Science CJFSBX, Vol. 42, No. 7, p 1303-1311, July 1985. 6 fig, 2 tab, 27 ref.

Descriptors: *Lake sediments, *Myriophyllum spicatum, *Phosphorus, *Pore water, *Ammonia, *Potassium, *Organic carbon, Nutrients, Plant physiology, Seasonal trends, Mineralization, Plant growth, Quebec, Canada, Vermont, Lake Memphremagog.

The distributions of porewater reactive phosphorus (RP), NH4(+), K, and inorganic carbon (sigmaCO2) were compared for sediments of Lake Memphremagog (Quebec-Vermont) colonized by Myriophyllum spicatum (9-40 g/sq m) and sediments experimentally maintained plant-free. Porewater nutrients were characterized by a high spatial and temporal variability. During the summer months, root activity induced marked reductions in porewater RP and NH4(+) between 5 and 38 cm. This trend reversed in spring and fall, however, when higher nutrient concentrations were observed in the colonized sediments, presumably as a result of root decay. Root activity was also associated with higher sigmaCO2 and K in the porewaters. Exchangeable NH4(+) was the largest pool of available N and exhibited a relatively rapid (9.5-24 day) turnover time in colonized sediments. The mineralization of organic matter is an important source of sediment NH4(+) and comparable in quantity with the N requirement of the macrophytes. These results suggest that under conditions of nutrient limitation, the rate of nutrient production from sedimentary organic matter decomposition may be a good predictor of macrophyte growth. (Author's abstract)
W87-01799

ION FLUX RATES, ACID-BASE STATUS, AND BLOOD GASES IN RAINBOW TROUT, SALMO GAIRDNERI, EXPOSED TO TOXIC ZINC IN NATURAL SOFT WATER,
Ontario Ministry of Natural Resources, Whitney. Harkness Lab. of Fisheries Research.
For primary bibliographic entry see Field 5C.
W87-01800

HISTORICAL RELATIONSHIPS BETWEEN PHOSPORUS LOADING AND BIOGENIC SILICA ACCUMULATION IN BAY OF QUINTE SEDIMENTS,
Michigan Univ., Ann Arbor. Great Lakes Research Div.
For primary bibliographic entry see Field 5C.
W87-01803

BENTHIC MACROINVERTEBRATES MODIFY COPPER AND ZINC PARTITIONING IN FRESHWATER-SEDIMENT MICROCOSMS,
Toronto Univ. (Ontario). Inst. for Environmental Studies.
G. Krantzberg, and P. M. Stokes.
Canadian Journal of Fisheries and Aquatic Sciences CJFSBX, Vol. 42, No. 9, p 1465-1473, September 1985. 3 fig, 4 tab, 47 ref.

Descriptors: *Benthic fauna, *Lake sediments, *Copper, *Zinc, *Metal partitioning, Microcosms, Lake Ontario, Chub Lake, Lohi Lake, Sudbury, Canada, Tubificid worms, Cladocera, Diptera, Oxidation-reduction potential, Bioturbation.

The effects of bioturbation on metal dynamics in freshwater-sediment systems using 8-l polyethylene tanks containing 283.5 sq cm of sediment 10 cm deep and 5 l of lake water were studied. In general, benthic macroinvertebrates caused significant changes in Cu and Zn partitioning among physicochemical forms in the sediment. The proportion of cation-exchangeable and specifically adsorbed Cu observed in Chub Lake (Muskoka-Haliburton, Canada) microcosms colonized by chironomids and chaoborids was greater than that for uncolonized sediment. The same relationship held for Cu in Lohi Lake (Sudbury) microcosms supporting a similar benthic community and for Cu and Zn in Port Credit (Lake Ontario) sediments inhabited by tubificids. The ability of tubificid worms to increase sediment E sub h was recorded and related to Cu and Zn dynamics. The authors conclude that macroinvertebrate communities have the potential to increase metal concentrations in the water column, particularly during short episodes of high burrowing activity, and that in situ studies are warranted to verify this potentiality. (Author's abstract)
W87-01804

HYPOLIMNETIC OXYGEN CONSUMPTION IN SMALL LAKES,
Toronto Univ. (Ontario). Dept. of Zoology.
R. R. Fulthorpe, and J. E. Paloheimo.
Canadian Journal of Fisheries and Aquatic Sciences CJFSBX, Vol. 42, No. 9, p 1493-1500, September 1985. 2 fig, 4 tab, 25 ref, append, NSERC (Canada) Grant A4900.

Descriptors: *Hypolimnion, *Lakes, *Morphometry, *Productivity, *Oxygen dynamics, *Iron, *Organic carbon, Chemistry, Ontario, Canada, Light, Decomposition rate, Stepwise multiple regression.

The hypolimnetic oxygen consumption rates of 28 Ontario (Canada) lakes were calculated and compared with lake morphology, chemical concentrations, and productivity measures. In most cases, hypolimnia had upper zones where average light intensities were greater than 1% of surface light. In these layers, oxygen dynamics were highly variable from year to year and production rather than consumption was common. The ratio of areal oxygen consumption below the 1% light level to planktonic production, corrected for retention, was studied as a measure of percent available material decomposed. Using stepwise multiple regressions, this parameter was shown to be related to mean thickness of the hypolimnion, lake organic carbon, and iron concentrations. The range of lake productivities in the data set was small and did not explain a significant portion of the variance in a real hypolimnetic depletion rates. (Author's abstract)
W87-01805

PATTERNS OF EPIPELIC ALGAL ABUNDANCE WITH DEPTH, TROPHIC STATUS, AND ACIDITY IN POORLY BUFFERED NEW HAMPSHIRE LAKES,
Louisville Univ., KY. Dept. of Biology.
R. J. Stevenson, R. Singer, D. A. Roberts, and C. W. Boylen.
Canadian Journal of Fisheries and Aquatic Sciences CJFSBX, Vol. 42, No. 9, p 1501-1512, September 1985. 1 fig, 10 tab, 30 ref. EPA Contract APP-0313-1983.

Descriptors: *Sediments, *Algae, *Buffering, *Lakes, *Benthic flora, *Depth, *Acidity, *Trophic level, Cyanophyta, Phosphorus, Chlorophyll a, Acid-neutralizing capacity, Hydrogen ion concentration, Biovolume, Light, Adaptation, Diatoms, Nutrient sequestration, Plant physiology.

The biovolume and species composition of algae on sediments in 20 poorly-buffered New Hampshire lakes were surveyed in autumn to delineate patterns of community structure and composition with acidity and trophic status of lakes, and along depth gradients within lakes. Patterns of total algal biovolume on sediments were not related strongly to these habitat conditions because of masking by algae that probably settled from the plankton onto sediments. Biovolumes of 'benthic' algae generally decreased with depth, but weak and postive correlations between biovolumes of some benthic algal taxa and depth indicated that benthic algae had adapted to low light conditions and were perhaps facultatively heterotrophic. Decreases in diatom and increases in blue-green algal biovolumes with total phosphorus and chlorophyll a concentrations in lake water indicated that blue-green algae were better adapted for sequestering nutrients in low light environments. The variability of patterns of algal biovolume and acid-neutralizing capacity (ANC) and pH indicated that algae had adapted well to different levels of ANC and pH. (Author's abstract)
W87-01806

VARIABILITY OF DENSITY ESTIMATES AND THE OPTIMIZATION OF SAMPLING PROGRAMS FOR STREAM BENTHOS,
McGill Univ., Montreal (Quebec). Dept. of Biology.
For primary bibliographic entry see Field 7A.
W87-01807

ESTIMATING THE STANDING BIOMASS OF AQUATIC MACROPHYTES,
Montreal Univ. (Quebec). Dept. of Biological Sciences.
J. A. Downing, and M. R. Anderson.
Canadian Journal of Fisheries and Aquatic Sciences CJFSBX, Vol. 42, No. 12, p 1860-1869, December 1985. 5 fig, 7 tab, 74 ref. Canadian National Sportsmen's Fund Grants 5-R33 and 6-R52.

Descriptors: *Sampling design, *Aquatic plants, *Cost analysis, *Biomass, *Spatial heterogeneity, Lake Orford, Lake Memphremagog, Quebec, Vermont. Accuracy, Precision, Statistics.

The accuracy, precision, and cost-efficiency of estimation techniques for macrophyte standing biomass were examined, and solutions are offered to problems encountered in the design of efficient sampling programs. Five sizes of quadrats (100 sq

cm to 1 sq m) were compared on seven occasions (in lakes Orford, Quebec and Memphremagog, Quebec-Vermont) and all five yielded equivalent biomass estimates in six of the tests. Published and unpublished values of biomass sampling variance measured around the world were predictable from average standing biomass and size of sampler. The sampling cost was predictable from sampler size. Analysis of these relationships allows optimization of sampling design. The use of small quadrat samplers with great replication is recommended. Adherence to this protocol can result in a 30-fold reduction in sampling cost. Recommendations were compared with the techniques actually used by aquatic ecologists. A brief analysis of spatial heterogeneity of aquatic macrophyte biomass is presented. (Author's abstract)
W87-01810

EFFECTS OF SUCCESSIVE FLOW PERTURBATIONS ON STREAM INVERTEBRATES,
Otago Univ., Dunedin (New Zealand). Dept. of Zoology.
J. R. Irvine.
Canadian Journal of Fisheries and Aquatic Sciences CJFSBX, Vol. 42, No. 12, p 1922-1927, December 1985. 1 fig, 6 tab, 30 ref.

Descriptors: *Flow pattern, *Artificial watercourses, *Benthic fauna, *Invertebrate drift, Surber samplers, Filamentous algae, River discharge.

Constant discharge was maintained in two manmade streams for several months, after which discharge was kept constant in one stream (control) and increased five-fold and then returned to its original state three times between 17:00 and 21:00 in one day (treatment). This treatment was repeated on four successive days each week for 3 wk. On the first day of the treatment, the density of invertebrate drift increased in the treatment stream during the changes in discharge, the increase being less with each successive change. By the final day of treatment, however, the changes in discharge did not cause increases in drift, a result which is attributed to the depletion of the benthos. Surber sampler estimates of benthic invertebrate density declined following flow changes. Many of the invertebrates displaced by flow changes probably were resident in sloughed off filamentous algae. The author concludes that it is necessary to know the flow history of a river before being able to predict effects of flow perturbations. (Author's abstract)
W87-01812

EFFECTS OF MANIPULATIONS OF ALUMINUM CONCENTRATIONS AND PH ON PHOSPHATE UPTAKE AND PHOTOSYNTHESIS OF PLANKTONIC COMMUNITIES IN TWO PRECAMBRIAN SHIELD LAKES,
Toronto Univ. (Ontario). Div. of Life Sciences.
For primary bibliographic entry see Field 5C.
W87-01814

INFLUENCE OF SNOWCOVER DEVELOPMENT AND GROUND FREEZING ON CATION LOSS FROM A WETLAND WATERSHED DURING SPRING RUNOFF,
Trent Univ., Peterborough (Ontario). Watershed Ecosystems Program.
For primary bibliographic entry see Field 5B.
W87-01815

PHYSIOLOGICAL RESPONSE OF JUVENILE RAINBOW TROUT, SALMO GAIRDNERI, TO ACID AND ALUMINUM - PREDICTION OF FIELD RESPONSES FROM LABORATORY DATA,
Ontario Ministry of the Environment, Rexdale. Aquatic Toxicity Unit.
For primary bibliographic entry see Field 5C.
W87-01818

HIGH-DENSITY CULTURE OF MEIOBENTHIC HARPACTICOID COPEPODS WITHIN A MUDDY SEDIMENT SUBSTRATE,
Louisiana State Univ., Baton Rouge. Dept. of Zoology and Physiology.
G. T. Chandler.
Canadian Journal of Fisheries and Aquatic Sciences CJFSBX, Vol. 43, No. 1, p 53-59, January 1986. 1 fig, 2 tab, 33 ref.

Descriptors: *Harpacticoid copepods, *Sampling, *High-density culture, *Sediments, Sieving, Dissolved organic compounds, Culture method, Sediment sorting.

Simple procedures are presented to: (1) sort muddy sediments into <125-micron size class; (2) flush away most dissolved organics; (3) sterilize the sediments, providing a moderately foul-free culture medium; (4) generate a life-like, flocculent surface layer; and (5) allow easy observation above or below the sediment surface. Five harpacticoid species were cultured within 45-90 days to densities 4-11 times their natural field maxima (per 10 sq cm): Scottolana canadensis (372), Paronychocamptus huntsmani (380), Onychocamptus mohammed (448), Cletocampus deitersi (1,259), and Nitocra lacustris (1,662). Since most mud-inhabiting harpacticoids are larger than 125 micron, simple sieving on a 125-micron screen eliminates culture sediments leaving behind hundreds of clean, easily collected harpacticoids. (Author's abstract)
W87-01820

RESPONSE OF RADIOACTIVE TRACE METALS TO ACID-BASE TITRATIONS IN CONTROLLED EXPERIMENTAL ECOSYSTEMS: EVALUATION OF TRANSPORT PARAMETERS FOR APPLICATION TO WHOLE-LAKE RADIOTRACER EXPERIMENTS,
Lamont-Doherty Geological Observatory, Palisades, NY.
For primary bibliographic entry see Field 5B.
W87-01821

RECENT MAJOR DECLINES IN ZOOPLANKTON POPULATIONS IN THE INSHORE REGION OF LAKE MICHIGAN: PROBABLE CAUSES AND IMPLICATIONS,
Michigan Univ., Ann Arbor. Great Lakes Research Div.
M. S. Evans.
Canadian Journal of Fisheries and Aquatic Sciences CJFSBX, Vol. 43, No. 1, p 154-159, January 1986. 2 fig, 1 tab, 21 ref.

Descriptors: *Zooplankton, *Lake Michigan, *Alewife, *Predation, *Yellow perch, Food chains, Size selectivity, Populations.

Summer zooplankton communities in the inshore region of southeastern Lake Michigan were dominated by small species during the 1970s, suggesting that size-selective fish predation pressures were intense. Abundances of alewife (Alosa pseudoharengus), the dominat planktivore in the 1970s, declined in recent years, especially over 1982-84. Despite decreased alewife predation, small zooplankton continued to predominate. Moreover, zooplankton standing stocks declined 10-fold during 1982-84, suggesting that predatory pressures had intensified. Concurrent with the alewife population decrease was a major increase in yellow perch (Perca flavescens) abundances. As a probable consequence of intense predation pressures exerted by abundant yellow perch, zooplankton standing stocks were reduced severely. Yellow perch populations may have been affected adversely by food limitation, especially in summer 1984, when zooplankton standing stocks were only 3% of their average level over 1975-81. (Author's abstract)
W87-01826

HISTOLOGICAL CHANGES IN CULTURED LAKE TROUT, SALVELINUS NAMAYCUSH, SUBJECTED TO CUMULATIVE LOADING IN A WATER REUSE SYSTEM,
National Fishery Research and Development Lab., Wellsboro, PA.
For primary bibliographic entry see Field 5C.
W87-01828

DOES ALGAL-BACTERIAL PHOSPHORUS PARTITIONING VARY AMONG LAKES. A COMPARATIVE STUDY OF ORTHOPHOSPHATE UPTAKE AND ALKALINE PHOSPHATASE ACTIVITY IN FRESHWATER,
Montreal Univ. (Quebec). Dept. of Biological Sciences.
D. J. Currie, E. Bentzen, and J. Kalff.
Canadian Journal of Fisheries and Aquatic Sciences CJFSBX, Vol. 42, No. 2, p 311-318, February 1986. 8 fig, 2 tab, 40 ref.

Descriptors: *Phytoplankton, *Limnology, *Bacteria, *Plankton, *Lakes, *Orthophosphates, *Accumulation, Size fractionation, Quebec, Canada, Vermont, New York, Particle size, Alkaline phosphatase activity, Enzymes, Phosphorus partitioning.

In order to distinguish the activity of phytoplankton and bacterioplankton in 13 lakes of widely varying trophy, located in the Quebec (Canada)-New York-Vermont borders, the authors size-fractionated orthophosphate uptake and alkaline phosphatase activity. In most lakes, orthophosphate uptake was associated consistently and overwhelmingly with the smallest particles. Based upon indicators of algal and bacterial presence in each size class, it is inferred that the bacterioplankton were responsible for >95% of the orphophosphate uptake in situ, except in lakes that were not P-deficient. In contrast, a large portion of the alkaline phosphatase activity was free in solution (median 46%), and much of the remainder (median 44%) was apparently associated with algae. (Author's abstract)
W87-01848

PHOSPHATE UPTAKE BY MICROORGANISMS IN LAKE WATER: DEVIATIONS FROM SIMPLE MICHAELIS-MENTEN KINETICS,
National Oceanic and Atmospheric Administration, Ann Arbor, MI. Great Lakes Environmental Research Lab.
S. J. Tarapchak, and L. R. Herche.
Canadian Journal of Fisheries and Aquatic Sciences CJFSBX, Vol. 43, No. 2, p 319-328, February 1986. 7 fig, 2 tab, 41 ref.

Descriptors: *Orthophosphates, *Limnology, *Accumulation, *Michaelis-Menten kinetics, *Lake Michigan, *Radioactive Tracers, Phosphorus-31, Woolf plots, Frequency distribution, Laboratory culture, Mathematical analysis.

Orthophosphate (31P sub i) uptake rates by natural Lake Michigan microbial assemblages were measured to test a hypothesis that the instantaneous velocity of 31P sub i uptake at low added substrate concentrations in higher than predicted by the simple Michaelis-Menten equation. Analysis of data from most experiments verified this prediction: 31P sub i turnover times (T sub calc) obtained by back-extrapolation from 'low' substrate regions in Woolf plots ranged from 25% to nearly 3,000% of those calculated from 'high' substrate regions. Simulation analysis demonstrated taht deviations in T sub calc could be at least an order of magnitude higher than previously predicted. Large (>1,000%) discrepancies from the simple Michaelis-Menten equation could be caused by 'skewed' or 'clumped' distributions, where the range in both species half-saturation constants (K sub t) and relative abundances is very wide and species with the lowest K sub t values are most abundant. A comparison of Kt values for mixed microbial assemblages in Lake Michigan (0.16-19.4 microgram (ug) P/liter) with those from laboratory culture studies (11-364 ug P/l) demonstrates that natural microbial populations have adapted to P-limited environments by synthesizing uptake systems that have K sub t values at least and order of magnitude below those detected in culture. (Author's abstract)
W87-01849

LIGHT HISTORY, PHOSPHORUS STATUS, AND THE OCCURRENCE OF LIGHT STIMULATION OR INHIBITION OF PHOSPHATE UPTAKE IN LAKE SUPERIOR PHYTOPLANKTON AND BACTERIA,

Scarborough Coll., Westhill (Ontario). Life Sciences Div.
C. Nalewajko, B. Paul, K. Lee, and H. Shear.
Canadian Journal of Fisheries and Aquatic Sciences CJFSBX, Vol. 43, No. 2, p 329-335, February 1986. 3 fig, 4 tab, 24 ref.

Descriptors: *Phosphates, *Limnology, *Regression analysis, *Light, *Lake *Phytoplankton, Superior, Accumulation, Stepwise multiple regression, *Mathematical models, Biovolume, Diurnal pattern.

Phosphate uptake in Lake Superior was stimulated by light on 17 of 34 occasions, inhibited in 10, and unaffected in 7. In a stepwise multiple regression model the variables explaining most of the variance in the light effect on phosphate uptake were, in decreasing order of importance, the light history as estimated by hours of sunshine in the previous 3 days, phosphate turnover time, phytoplankton biovolume, and time of day. Stimulation was most common in spring at inshore stations, whereas inhibition occurred mainly in spring at offshore stations. The authors suggest that light-limited but phosphorus-sufficient phytoplankton show the former, but extremely low light adapted populations, the latter response. An apparent diurnal pattern in the response was discovered, with maximal stimulation by light during daylight hours and inhibition predominating at sunrise and sunset. (Author's abstract)
W87-01850

DYNAMICS OF LAKE MICHIGAN NATURAL PHYTOPLANKTON COMMUNITIES IN CONTINUOUS CULTURES ALONG A SI:P LOADING GRADIENT,
Michigan Univ., Ann Arbor. Div. of Biological Sciences.
S. S. Kilham.
Canadian Journal of Fisheries and Aquatic Sciences CJFSBX, Vol. 43, No. 2, p 351-360, February 1986. 4 fig, 4 tab, 31 ref. NSF Grants OCE78-27016 and OCE81-17377.

Descriptors: *Phytoplankton, *Limnolology, *Silicon, *Phosphorus, *Atomic ratio, *Gradients, *Lake Michigan, *Diatoms, Chlorophyta, Stable coexistence, Competition, Continuous culture.

The hypothesis that phytoplankton species assort themselves along resource ratio gradients according to their relative competitive abilities for the potentially limiting resources was tested using natural communities from Lake Michigan. Algae were grown in six continuous cultures for 46 days on a gradient consisting of four silicon to phosphorus (Si:P) ratios: 313:1 (two cultures), 71:1, 4.6:1, and 0.9:1 (two cultures). Diatoms were the superior competitors for P and dominated the three high Si:P ratio cultures at steady state. Green algae dominated the three low Si:P ratio cultures. The two cultures at Si:P = 313 were very similar and were dominated by the diatom Synedra filiformis. Stable coexistence was demonstrated at Si:P =71, where S. filiformis and Diatom elongatum co-occurred. The three low Si:P ratio cultures were dominated by a green unicell. Six common species, including the three dominant species, were isolated and tested for their abilty to grow under limitation by Si and P. Trade-offs in competitive ability predicted from continuous culture results were confirmed. Species were ranked in competitive ability for Si as follows: the green unicell and Monoraphidium contortum (green alga, with no Si requirements) were better than D elongatum and Asterionella formosa, which were better than S filiformis and Fragilaria crotonensis. The ranking for P was exactly the opposite. (Author's abstract)
W87-01851

RADIOTRACER STUDY OF PHOSPHORUS CYCLING IN A EUTROPHIC CANADIAN SHIELD LAKE, LAKE 227, NORTHWESTERN ONTARIO,
Department of Fisheries and Oceans, Winnipeg (Manitoba). Freshwater Inst.
S. N. Levine, M. P. Stainton, and D. W. Schindler.
Canadian Journal of Fisheries and Aquatic Science CJFSBX, Vol. 43, No. 2, p 366-378, February 1986. 10 fig, 1 tab, 49 ref. EPA Cooperative Agreement CR811060.

Descriptors: *Phosphorus-32, *Cycling nutrients, *Limnology, *Eutrophication, *Radioactive tracers, *Bacteria, *Phytoplankton, Experimental Lakes Area, Lake 227, Ontario, Canada, Littoral zone, Macrophytes, Sedimentation, Lake sediments, Hypolimnion, Epilimnion, Phosphorus cycling.

Phosphoric acid labeled with 32P was added to the epilimnion of experimentally-eutrophied Lake 227, in the Experimental Lakes Area, northwestern Ontario, in August 1978, to trace the lake's P cycle during late stratification and fall overturn. Radiophosphate was incorporated into bacteria and microphytoplankton (<10 micron (um) diameter) within minutes of its introduction. Thereafter, most 32P exchange was between the microplankton, which typically held >90% of 32P, dissolved phosphate, and a mobile subcompartment of 'dissolved organic' P. Phytoplankton >10 um in diameter and zooplankton acquired 32 P label very slowly and contained <5% of the radiotracer. About half the dissolved organic P failed to acquire a 32P label over 17 days of incubation, indicating that this P may be functionally inert, at least at the time scale of biological P exchange. Movement of 32P to the littoral zone of Lake 227 was much slower than in lakes with well-developed macrophyte communities, but losses to deep sediments were similar, ie, about 2% of 32P/day. Particles settled through the hypolimnion at a modal velocity of 28 cm/day, losing 10% or less of their 32 P during descent. Most of the released P was reincorporated into particles and sedimented. Less than 1% of the 32P that entered the hypolimnion in particles between August and October remained in the hypolimnion in late October. Release of 32P from hypolimnetic sediments during late summer and fall was <5% of the 32P that sedimented. (Author's abstract)
W87-01852

NUTRIENT STATUS OF PHYTOPLANKTON BLOOMS IN NORWEGIAN WATERS AND ALGAL STRATEGIES FOR NUTRIENT COMPETITION,
Trondheim Univ. (Norway). Biological Station.
E. Sakshaug, and Y. Olsen.
Canadian Journal of Fisheries and Aquatic Sciences CJFSBX, Vol. 43, No. 2, p 389-396, February 1986. 2 fig, 4 tab, 49 ref.

Descriptors: *Norway, *Eutrophication, *Limnology, *Phytoplankton, Freshwater, Brackish water, Nitrogen, Phosphorus, Nutrient ratios, Estuaries, Oceans, Lakes, Fjords, Nutrient limiation, Salinity, Wastewater pollution, Biomass, Chemostat, Competition.

Results of studies of phytoplankton blooms in Norwegian waters, conducted since 1977, are summarized; studies extended from oceanic waters via fjords to lakes. During blooms phytoplankton communities are P limited in fresh and brackish waters, and balanced, or even N limited, in high-salinity marine waters. This results from the high N/P ratio for available nutrients before the onset of blooms in freshwater relative to seawater (N/P (atoms) >100 and 12-16, respectively). Algal N/P ratios at nutrient saturation vary between 8 and 27 among species, and average 16. A low ratio at nutrient saturation may imply P limitation even in high-salinity waters (eg, Skeletonema costatum). In general, nutrient deficiency becomes more pronounced as the biomass increases. Addition of sewage shifts natural systems toward N limitation, which may therefore be a secondary effect of accelerated eutrophication. Interspecific competition in nutrient-limited communities depends on the nutrient requirement of individual species and the mode of nutrient uptake. In an example described here, Staurastrum luetkemuellerii outcompeted Microcystis aeruginosa in a chemostat when the nutrient supply was continuous; the opposite happened when nutrient supply was pulsed. (Author's abstract)
W87-01853

PHOSPHORUS ENRICHMENT, SILICA UTILIZATION, AND BIOGEOCHEMICAL SILICA DEPLETION IN THE GREAT LAKES,
Michigan Univ., Ann Arbor. Great Lakes Research Div.
C. L. Schelske, E. F. Stoermer, G. L. Fahnenstiel, and M. Haibach.
Canadian Journal of Fisheries and Aquatic Sciences CJFSBX, Vol. 43, No. 2, p 407-415, February 1986. 4 fig, 7 tab, 25 ref. DOE Contract C00-2003-46, EPA Grants R806294, R810396; NSF Grant OCE-82165888, EPA Grant R810396.

Descriptors: *Lake Erie, *Lake Ontario, *Lake Michigan, *Lake Huron, *Silica, *Diatoms, *Phosphorus enrichment, *Phytoplankton, *Light, *Primary productivity, Sedimentation, Silicon cycling, Mathematical models, Thermal stratification.

Two questions are discussed: How much can the rate of Si utilization by diatoms in the Great Lakes be affected by P enrichment.; and, What mechanism(s) have produced the severe Si depletion that characterizes the entire water column in Lake Ontario and the eastern and central basins of Lake Erie. Four sets of experiments with natural phytoplankton assemblages in water collected from Lake Michigan were used to determine Si uptake under different P, other nutrient, and light conditiions. Increased Si uptake by diatoms with relatively small P enrichments was demonstrated. Severe Si depletion (< or = 0.39 mg SiO2/liter) prior to thermal stratification) is proposed to result when P levels are increased to the extent that increased diatom production reduces Si concentrations to limiting levels during the thermally mixed period. Large P enrichments such as those characterizing the eastern and central basins of Lake Erie and Lake Ontario in the early 1970s are necessary to produce severe Si depletion. Severe Si depletion in the lower lakes was produced by P enrichment as evidenced by the smaller P concentrations in the inflowing waters from Lake Huron and larger Si concentrations in the outflowing waters of Lakes Erie and Ontario. The model proposed for biogeochemical Si depletion is consistent with previous findings of high rates of internal recycling because, under steady-state conditions for Si inputs, any increase in diatom production will produce an increase in permanent sedimentation of biogenic Si, provided some fraction of the increased biogenic Si production is not recycled or unless there is a compensating increase in the dissolution of diatoms. (Rochester-PTT)
W87-01855

INFLUENCE OF SALMONINE PREDATION AND WEATHER ON LONG-TERM WATER QUALITY TRENDS IN LAKE MICHIGAN,
National Oceanic and Atmospheric Administration, Ann Arbor, MI. Great Lakes Environmental Research Lab.
For primary bibliographic entry see Field 5B.
W87-01856

LIMNETIC ZOOPLANKTON ASSEMBLAGES IN ATLANTIC CANADA WITH SPECIAL REFERENCE TO ACIDIFICATION,
Waterloo Univ. (Ontario). Dept. of Biology.
For primary bibliographic entry see Field 5B.
W87-01857

WETLAND ECOSYSTEM STUDIES FROM A HYDROLOGICAL PERSPECTIVE,
Geological Survey, Denver, CO. Water Resources Div.
J. W. LaBaugh.
Water Resources Bulletin WARBAQ, Vol. 22, No. 1, p 1-10, February 1986. 3 tab, 55 ref.

Descriptors: *Wetlands, *Hydrologic budget, *Groundwater, Review articles, Chemical budget, Input-output relationship, Biogeochemical processes, Ecosystem research, Hydrology, Ecosystems.

Selected studies from the literature were reviewed to determine the extent of knowledge about the relationship between hydrology and wetland ecosystem studies. Wetland studies of chemical input-

output relationship have been the most dependent on hydrologic data of all wetland investigations; yet, very few of these studies have attempted to measure all components of a wetland's water balance. Usually, unmeasured components were calculated as the difference between measured inputs and outputs. Ground water was frequently overlooked. Chemical input-output investigations primarily were concerned with determining the amount of input retained in the wetlands. Few studies also included direct measurement of biogeochemical processes within wetlands of elements that were part of simultaneous input-output investigations. The importance of uncertainties in chemical budgets that are due to uncertainties in hydrologic budgets has been addressed in very few wetland investigations. Although many studies have emphasized the importance of hydrology to wetland ecosystem research, few studies have documented this, so that hydrology remains one of the least understood components of wetlands ecosystems. (Author's abstract)
W87-01881

ALGAL BIOASSAY AND GROSS PRODUCTIVITY EXPERIMENTS USING SEWAGE EFFLUENT IN A MICHIGAN WETLAND,
Duke Univ., Durham, NC. School of Forestry and Environmental Studies.
For primary bibliographic entry see Field 5C.
W87-01894

NEBRASKA'S SANDHILLS LAKES: A HYDROGEOLOGIC OVERVIEW,
Nebraska Univ., Lincoln. Conservation and Survey Div.
M. Ginsberg.
Water Resources Bulletin WARBAQ, Vol. 21, No. 4, p 573-578, August 1985. 4 fig, 11 ref.

Descriptors: *Lakes, *Surface-groundwater relation, *Hydrology, *Geology, Nebraska, Sandhills, Marshes, Meadows, Climatology, Groundwater, Reservoirs, Chemical characteristics, Water quality, Organic matter.

The available information pertaining to the hydrogeology of Nebraska's Sandhills lakes is summarized and updated. Lakes, marshes and wet meadows occur in the broad, flat, interdune valleys of the Nebraska Sandhills, a vegetation-stabilized dune field underlain by sediments containing an enormous supply of groundwater. Hydrologic, geologic and possibly climatologic factors influence the chemical quality of lake water. Central and eastern lakes generally are in connection with the groundwater reservoir. The hydrologic nature of western lakes and the cause of their high alkalinity is not fully understood. Lakes in close proximity may vary in both their chemical characteristics and in the degree to which they change in size and depth over time. Climatic, hydrogeologic and natural lake-aging processes of accumulation of organics appear to be primarily responsible for lake size variations. Differences in water quality among lakes are dependent on such factors as time elapsed since a precipitation event, lake age, and, in the case of a lake hydraulically connected with adjacent groundwater, the nature of the sediments through which the groundwater percolates before entering the lake. Some of the more highly alkaline lakes supplied potash during World War I. Some lakes seasonally vary considerably in size while others remain virtually unchanged in size. Even if groundwater levels remain fairly stable, a Sandhills lake will gradually become shallower, primarily due to accumulation of organic matter from organisms living and dying within the lake. Eolian processes contribute sand and finer materials removed from dunal blowouts and dunal alluvial fans. Water causes erosion of dunes and depositions of dunal material into immediately adjoining lakes. (Peters-PTT)
W87-01898

CHLOROPHYLL-BIOMASS-NUTRIENT RELATIONSHIPS FOR NATURAL ASSEMBLAGES OF FLORIDA PHYTOPLANKTON,
Florida Univ., Gainesville. Center for Aquatic Weeds.
D. E. Canfield, Jr., S. B. Linda, and L. M. Hodgson.
Water Resources Bulletin WARBAQ, Vol. 21, No. 3, p 381-391, June 1985. 6 fig, 3 tab, 22 ref. DOI Project 14-16-0009-79-064.

Descriptors: *Limnology, *Chlorophyll, *Biomass, *Phytoplankton, Florida, Lakes, Chlorophyll, Nitrogen, Algae, Phosphorus, Regression analysis, Reservoirs.

The chlorophyll-biomass relationship for natural assemblages of phytoplankton collected from a large number of warm temperate and subtropical Florida lakes is examined. The factors that influence the chlorophyll to biomass ratio are examined and the chlorophyll-nutrient and Secchi-chlorophyll relationship are compared to their corresponding biomass-nutrient and Secchi-biomass relationships. Parallel determination of phytoplankton biomass and chlorophyll concentration were made on spring and summer phytoplankton samples collected from 165 Florida lakes. There was a significant correlation between chlorophyll concentration and phytoplankton biomass. Chlorophyll content per unit phytoplankton biomass ranged over two order of magnitude. Nitrogen seemed to be a major factor influencing the chlorophyll content of Florida algae. Multiple regression analyses indicated that phytoplankton biomass was dependent on both the total phosphorus and total nitrogen concentration. Nutrient-phytoplankton and Secchi-phytoplankton relationships for the Florida lakes had higher coefficients of determination if chlorophyll concentrations rather than phytoplankton biomass data were used in regression analyses. The utility of chlorophylla measurements is especially apparent when large numbers of samples are needed to characterize the limnology of a lake or reservoir. (Peters-PTT)
W87-01910

PREDICTIVE MODELS FOR THE BIOMASS OF BLUE-GREEN ALGAE IN LAKES,
North Carolina Univ. at Chapel Hill. Dept. of Biology.
V. H. Smith.
Water Resources Bulletin WARBAQ, Vol. 21, No. 3, p 433-439, June 1985. 3 fig, 8 tab, 52 ref.

Descriptors: *Algae, *Eutrophication, *Limnology, *Biomass, Blue-green algae, Lakes, Water quality management, Chlorophyll, Bay of Quinte, Lake Ontario, Saginaw Bay, Lake Huron, Heart Lake, Lake Trummen, Sodra Bergundasjon, Sweden, Phosphorus.

A series of models is developed to predict the biomass of blue-green algae in lakes and their potential use in water quality management is discussed. In lakes which experience water quality problems due to the nuisance growth of blue-green algae, summer concentrations of chlorophyll may not always be a meaningful measure of water quality for making management decisions. Models for the prediction of summer mean blue-green algal biomass were developed from data collected from the following five systems located in North America and Sweden: Bay of Quinte, Lake Ontario; Saginaw Bay, Lake Huron; Heart Lake; Lake Trummen; and Sodra Bergundasjon. It is suggested that the model of choice is log BG = -0.142 + 0.596 log TP - 0.963 log Z, where BG is the biomass of blue-green algae, TP is the concentration of total phosphorus, and Z is the mean depth of the lake. When coupled to current loading models, this model can potentially be used to assess the impacts of phosphorus loading reductions on threshold odor in water supplies. (Peters-PTT)
W87-01915

AIRBORNE THERMAL MAPPING OF A FLOW-THROUGH LAKE IN THE NEBRASKA SANDHILLS,
Nebraska Univ., Lincoln. Conservation and Survey Div.
D. Rundquist, G. Murray, and L. Queen.
Water Resources Bulletin WARBAQ, Vol. 21, No. 6, p 989-994, December 1985. 3 fig, 19 ref.

Descriptors: *Surface-groundwater relations, *Mapping, *Remote sensing, *Groundwater, *Lakes, Sandhills, Nebraska, Sand dunes, Meadows, Precipitation, Runoff, Ogallala Group, Marshes, Crescent Lake, Blue Lake, Hackberry Lake.

The Sandhills region of Nebraska accounts for nearly one-fourth (or 57,000 sq km) of the state's total area and represents the largest sand sea in the western hemisphere. This unique region consists of stabilized sand dunes modified by deflation hollows (blowouts), large interdunal wet meadows, and numerous natural lakes. The average annual precipitation for the Sandhills ranges from 63.5 cm in the east to 40 cm in the west, very little of which results in surface runoff due to the sandy soil. The region recharges the underlying Ogallala Group, a tremendous ground water reserve amounting to approximately 930,000 cu m of water. Small shallow lakes, marshes, and subirrigated meadows are abundant due to interactions between ground water and surface water. One theory relating ground water to lake flow systems in the Sandhills has been termed the flow-through concept. A flow-through lake is essentially a topographic depression that extends below a water table and, due to the slope of that saturated surface, the ground water flows in from the upgradient end of the lake and discharges from the downgradient end. Data from Crescent Lake, Blue Lake and Hackberry Lake are the result of a Thermal Infrared Multispectral Scanner (TIMS) overflight in the late afternoon of August 13, 1983, an extremely hot day. A digital contrast stretch was employed to utilize the full display range of the storage medium, thereby accentuating subtle variations within the lakes themselves. The work provides evidence that Crescent and Blue Lakes behave, at least part of the time, according to the flow-through principles while Hackberry Lake possesses a more complex system of ground-water/surface interactions. (Peters-PTT)
W87-01933

WETLAND BOUNDARIES IN THE NEW JERSEY PINELANDS: ECOLOGICAL RELATIONSHIPS AND DELINEATION,
Rutgers - The State Univ., New Brunswick, NJ. Center for Coastal and Environmental Studies.
C. T. Roman, R. A. Zampella, and A. Z. Jaworski.
Water Resources Bulletin WARBAQ, Vol. 21, No. 6, p 1005-1012, December 1985. 6 fig, 1 tab, 19 ref.

Descriptors: *Wetlands, *Vegetation, *Protection, *New Jersey, *Pinelands, Regulations, Guidelines, Cooper Branch, Middle Branch Mount Misery Brook, South Branch Mount Misery Brook, Rancocas Creek, Lebanon State Park.

Wetland protection regulations and guidelines often require the delineation of precise wetland boundaries on a case-by-case basis. This study, conducted in the New Jersey Pinelands, presents an ecological characterization of vegetation composition, soil and hydrologic relationships along upland to wetland Pinus rigida-dominated transitions and provides the basis for a multiparameter approach to wetland boundary delineation. The transitional data set was analyzed by direct gradient analysis, cluster analysis and ordination. The study sites are associated with Cooper Branch, Middle Branch Mount Misery Brook, and South Branch Mount Misery Brook; all located within the North Branch Rancocas Creek watershed and located in Lebanon State Forest (Burlington County, New Jersey). It is concluded that vegetation composition can be a principal factor in delineating wetland boundaries along natural upland to wetland transitions. However, where distinct vegetation changes are not observed, a feature of these study sites, a multiparameter approach should be used. (Peters-PTT)
W87-01935

SEASONAL DISTRIBUTION OF FACULTATIVELY ENTEROPATHOGENIC VIBRIOS (VIBRIO CHOLERAE, VIBRIO MIMICUS, VIBRIO PARAHAEMOLYTICUS) IN THE FRESHWATER OF THE ELBE RIVER AT HAMBURG,
Hygienisches Inst. (Germany, F.R.).

J. Bockemuhl, K. Roch, B. Wohlers, V. Aleksic, and S. Aleksic.
Journal of Applied Bacteriology JABAA4, Vol. 60, No. 5, p 435-442, May 1986. 2 fig, 2 tab, 32 ref.

Descriptors: *Vibrio, *Enteric bacteria, *Rivers, *Aquatic environment, *Elbe River, *Seasonal distribution, Bacteria, Aquatic bacteria, Environment, Distribution, Pathogenic bacteria, Human diseases, Diseases.

Between June 1981 and December 1982, the incidence of Vibrio cholerae, V. mimicus, and V. parahaemolyticus was determined at two sampling sites on the Elbe River at Hamburg. A total of 183 strains was isolated from 147 water samples. Of these, 107 belonged to non-01 V. cholerae (10 strains producing a cholera-like enterotoxin); 33 were identified as V. mimicus, including two enterotoxin producers; 42 strains were Kanagawa-negative cultures of V. parahaemolyticus; and one was V. fluvialis. Highest incidence was observed from June to September with about 100 organisms/l. Halophilic vibrios were detectable during the period June/July to October (fewer than five organisms/l). The vibrio incidence was not influenced by the numbers of aerobic heterotrophic bacteria, coliforms, or fecal bacteria. In general, water temperature correlated with the seasonal variation. Thus, a temperature rise more than 10 to 20 C was followed parameters, only chloride concentration might have influenced the seasonal variation. It is concluded that the three Vibrio species are indigenous organisms of the Elbe River. (Author's abstract)
W87-01957

ANTIBIOTIC RESISTANT BACTERIA IN WINDERMERE AND TWO REMOTE UPLAND TARNS IN THE ENGLISH LAKE DISTRICT,
Freshwater Biological Association, Ambleside (England).
J. G. Jones, S. Gardener, B. M. Simon, and R. W. Pickup.
Journal of Applied Bacteriology JABAA4, Vol. 60, No. 5, p 443-453, May 1986. 8 tab, 28 ref.

Descriptors: *Windermere, *English Lake Districts, *Bacteria, *Tarns, *Lakes, *Aquatic bacteria, *Antibiotic resistance, England, Bacterial physiology, Coliforms, Streptococcus, Pseudomonas, Wastewater.

The incidence of antibiotic resistance was determined in more than 2000 bacteria which were divided into the following groups: fecal streptococci, coliforms (excluding Escherichia coli), E. coli, Pseudomonas spp., and other aquatic bacteria. The isolates were obtained from the water of Windermere (English Lake District) and from a sewage effluent which entered the lake. With the exception of the fecal streptococci, the incidence of antibiotic resistance was higher in the bacteria isolated from the lake water than in those from the effluent, and ranked as follows: Pseudomonas spp. > E. coli > aquatic bacteria > coliforms > fecal streptococci. The highest incidence of multiple resistance was found among the pseudomonads. When corrected for the relative population size, the pool of antibiotic resistance in the aquatic bacteria was by far the largest. The incidence of antibiotic resistance in aquatic bacteria isolated from Windermere was lower than in those isolated from two remote upland tarns. The upland tarns did not receive any sewage or other effluents, and therefore the results were surprising. Possible explanations include a lack of susceptibility in aquatic bacteria and increased resistance associated with growth in nutrient-poor environments. (See also W87-01959) (Author's abstract)
W87-01958

FACTORS AFFECTING THE MEASUREMENT OF ANTIBIOTIC RESISTANCE IN BACTERIA ISOLATED FROM LAKE WATER,
Freshwater Biological Association, Ambleside (England).
J. G. Jones, S. Gardener, B. M. Simon, and R. W. Pickup.
Journal of Applied Bacteriology JABAA4, Vol. 60, No. 5, p 455-462, May 1986. 8 tab, 13 ref.

Descriptors: *Antibiotics, *Antibiotic resistance, *Bacteria, *Lakes, *Aquatic bacteria, *Bacterial physiology, Pseudomonas, Culturing techniques, Habitats, Aquatic habitats, Species composition.

It is difficult to obtain a reliable assessment of antibiotic resistance in populations of aquatic bacteria. Factors influencing the results include the taxa involved, their site of origin, and the media and methods employed for isolating, subculturing, and testing them. Examples of these effects are provided. The resistance profiles obtained with populations of aquatic pseudomonads depend on the species composition of the population. Resistance patterns in aquatic bacteria varied with the site from which they were isolated; a higher incidence of resistance was recorded along shorelines and in sheltered bays than in the open water. The inclusion of antibiotics in the media employed for primary isolation increased the number of individual and multiple resistances recorded. The medium used to conduct the test also affected the results, and many aquatic bacteria failed to grow on some media. It is recommended that the sensitivity disc method be adopted for aquatic bacteria because it permits interpretation of a wider range of response. (See also W87-01958) (Author's abstract)
W87-01959

EMPIRICAL ANALYSIS OF ZOOPLANKTON COMMUNITY SIZE STRUCTURE ACROSS LAKE TROPHIC GRADIENTS,
McGill Univ., Montreal (Quebec). Dept. of Biology.
M. L. Pace.
Limnology and Oceanography LIOCAH, Vol. 31, No. 1, p 45-55, January 1986. 2 fig, 4 tab, 50 ref.

Descriptors: *Zooplankton, *Limnology, *Lakes, *Trophic level, *Size structure, *Community, *Phosphorus, *Chlorophyll, Copepods, Rotifers, Protozoa, Cladocera, Nauplii, Quebec, Regression models, Correlation, Biomass, Canada, Ecology.

The hypothesis was tested at 12 sites in Quebec (Canada) that zooplankton community size structure shifts toward an increased relative biomass of microzooplankton with increased lake trophy. The seasonal mean abundance and biomass of ciliates, rotifers, nauplii, cladocerans, and cyclopoid copepods were significantly related to lake trophy, but calanoid copepod abundance and biomass varied independently of lake trophy. Regressions of microzooplankton and macrozooplankton biomass with total phosphorus (TP) were highly significant, and TP explained a large proportion of the total variation. The regression models for microzooplankton and macrozooplankton were not significantly different, refuting the hypothesis that relative biomass changes with lake trophy. A community structure index (the slope of the log weight-log abundance relationship) and mean lengths of various taxa were analyzed, indicating that zooplankton community size structure was not correlated with either TP or chlorophyll. The inverse relationship between body size and specific flux rates suggests that microzooplankton account for most of the zooplankton community rates. (Author's abstract)
W87-01972

RECENT SHIFTS IN DAPHNIA COMMUNITY STRUCTURE IN SOUTHEASTERN LAKE MICHIGAN: A COMPARISON OF THE INSHORE AND OFFSHORE REGIONS,
Michigan Univ., Ann Arbor. Great Lakes Research Div.
M. S. Evans, and D. J. Jude.
Limnology and Oceanography LIOCAH, Vol. 31, No. 1, p 56-67, January 1986. 5 fig, 1 tab, 58 ref.

Descriptors: *Daphnia, *Yellow perch, *Bloaters, *Alewife, *Lake Michigan, Crustacea, Community, Predation, Seasonal distribution.

Before 1982, Daphnia retrocurva and D galeata mendotae were the dominant species of Daphnia in Lake Michigan. Between 1972 and 1981, Daphnia community structure in the offshore region shifted toward greater dominance of the larger D galeata mendotae, with D pulicaria, another large species, dominating by 1982. This continued through summer 1984. Shifts in offshore Daphnia community structure appear to be related to a reduction in predation pressure by declining alewife (Alosa pseudoharengus) populations and a hypothesized increase in relative predation pressure by Mysis relicta. From 1972 to 1984, Daphnia community structure changed only slightly in the inshore region; D retrocurva generally remained the summer and autumn dominant. However, summer Daphnia abundances decreased after 1980 as yellow perch (Perca flavescens) and bloater (Coregonus hoyi) increased. From an examination of historic data, the authors conclude that inshore region Daphnia populations probably have changed little since the late 1880's. The 1982-1984 offshore Daphnia complex, however, differed markedly from the earliest (mid-1950s) record of zooplankton community structure in this region of southeastern Lake Michigan. (Author's abstract)
W87-01973

SOURCES OF CARBON AND SULFUR NUTRITION FOR CONSUMERS IN THREE MEROMICTIC LAKES OF NEW YORK STATE,
Indiana Univ. at Bloomington. Dept. of Biology.
B. Fry.
Limnology and Oceanography LIOCAH, Vol. 31, No. 1, p 79-88, January 1986. 2 fig, 3 tab, 34 ref. NASA Grant NGR 15-003-118, NSF Grant PCM 79-10747.

Descriptors: *Plankton, *Limnology, *Bacteria, *Carbon, *Sulfur, *Nutrition, *Meromictic lakes, Isotope studies, Fayetteville Green Lake, Round Lake, Green Lake, New York, Detritus, Phytoplankton, Food webs, Littoral zone, Aquatic plants, Bacterial physiology.

The trophic importance of bacterioplankton as a source of C and S nutrition for consumers in meromictic lakes was tested in Fayetteville Green Lake, Round Lake, and Green Lake, near Syracuse, New York, using stable C (delta13C) and S (delta34S) isotopic measurements. Most consumers ultimately derive their C and S nutrition from a mixture of terrestrial detritus, phytoplankton, and littoral vegetation, rather than from bacterioplankton. Food webs in these meromictic lakes are thus similar to those in other lakes that lack dense populations of bacterioplankton. (Author's abstract)
W87-01974

BIOGEOCHEMICAL CYCLING OF LIGNOCELLULOSIC CARBON IN MARINE AND FRESHWATER ECOSYSTEMS: RELATIVE CONTRIBUTIONS OF PROCARYOTES AND EUCARYOTES,
Georgia Univ., Athens. Dept. of Microbiology.
R. Benner, M. A. Moran, and R. E. Hodson.
Limnology and Oceanography LIOCAH, Vol. 31, No. 1, p 89-100, January 1986. 5 fig, 4 tab, 31 ref. NSF Grants OCE 81-17834, BSR 81-14823, and BSR 82-15587, NOAA Grant NA 80AA-D00091.

Descriptors: *Decomposition, *Lignin, *Polysaccharides, *Cellulose, *Salt marshes, *Bacteria, *Fungi, *Mangrove swamps, *Okefenokee Swamp, *Big Cypress Swamp, Georgia, Florida, Bahamas, Ecology, Isotope studies.

Degradation of the lignin and polysaccharide components of lignocellulosic detritus was studied in a salt marsh on Sapelo Island, Georgia; a mangrove swamp on Andros Island, Bahamas; the Okefenokee Swamp in southern Georgia, and the Big Cypress Swamp in southwest Florida. Two independent methods - physical separation of bacteria from fungi and other eucaryotes by size fraction, and antibiotic treatments - were used to estimate procaryotic and eucaryotic contributions to the degradation of (14C-lignin)lignocelluloses and (14C-polysaccharide)lignocelluloses in samples of water and decaying plant material from each environment. Results of the two methods were similar; bacteria were the predominant degraders of lignocellulose in each of the aquatic ecosystems. Fungi and other eucaryotes contributed only minimally to overall degradation of lignocellulose in both

marine ecosystems and in the Okefenokee Swamp, but did contribute significantly to lignocellulose degradation in the Big Cypress Swamp. (Author's abstract)
W87-01975

CHLOROPHYLL PRODUCTION, DEGRADATION, AND SEDIMENTATION: IMPLICATIONS FOR PALEOLIMNOLOGY,
Notre Dame Univ., IN. Dept. of Biology.
S. R. Carpenter, M. M. Elser, and J. J. Elser.
Limnology and Oceanography LIOCAH, Vol. 31, No. 1, p 112-124, January 1986. 6 fig, 4 tab, 50 ref. NSF Grant BSR 83-08918.

Descriptors: *Chlorophyll, *Limnology, *Paleolimnology, *Decomposition, *Sedimentation, *Lakes, Michigan, Photodegradation, Detritus, Pigments, Pheophorbide, Sedimentary chlorophyll degradation products, Paleolimnology, Grazing, Biomass, Cladocera, Copepods.

Chlorophyll a production, degradation, and sedimentation were studied simultaneously during summer stratification in three lakes of contrasting plankton communities (Paul, Peter, and Tuesday Lakes, which are about 0.5 km apart on the same moraine in Gogebic County, Michigan). Pigment budgets showed that chlorophyll production and pigment resuspension were both major sources of water column pigments. Photodegradation rates were rapid and indicated that detritus particles that remained in the epilimnion for periods longer than about 3 days lost nearly all detectable pigments. Therefore, only rapidly sinking detrital particles or those produced in deep layers at low light intensity could make appreciable contributions to sedimentary chlorophyll degradation products. Pheophorbide a, a grazing indicator, was the dominant chlorophyll a degradation product found in sediment traps. Pigment sedimentation increased significantly with mean size of cladocerans and omnivorous copepods. In contrast, sedimentation rates of chlorophyll degradation products did not increase with primary production. The deposition of chlorophyll degradation products in sediments depended primarily on the size and biomass of grazers. (Author's abstract)
W87-01977

DOMINANT PROCESSES OF SEDIMENT DISTRIBUTION AND FOCUSING IN A SMALL, EUTROPHIC, MONOMICTIC LAKE,
Freshwater Biological Association, Ambleside (England).
J. Hilton, J. P. Lishman, and P. V. Allen.
Limnology and Oceanography LIOCAH, Vol. 31, No. 1, p 125-133, January 1986 2 fig, 1 tab, 43 ref.

Descriptors: *Monomictic lakes, *Sedimentation, *Sediment transport, *Sediment focusing, Suspended sediments, *Eutrophic lakes, *Turbidity, Esthwaite Water, United Kingdom, Sediment traps, Wave action.

Sediment accumulation rates measured from a common horizon in cores from 64 sites in Esthwaite Water, United Kingdom, were used to determine the relative importance of 10 mechanisms on the distribution of sediments in the lake. River inflows generally produced localized effects, but there were indications of periodic turbidity flows to the deepest point of the lake from the major inflow. Active sediment focusing processes were the dominant distribution mechanisms, a major resuspension of sediment at autumn overturn being the most important. The remaining variance was much greater than observed in similar work elsewhere, suggesting that redistribution of sediment by direct and indirect wave action may be taking place all over the lakebed during isothermal periods. The relative contributions of the different processes were corroborated by analysis of previously published sediment trap data. (Author's abstract)
W87-01978

MECHANISMS OF HYDROGEN ION NEUTRALIZATION IN AN EXPERIMENTALLY ACIDIFIED LAKE,
Oak Ridge National Lab., TN. Environmental Sciences Div.
For primary bibliographic entry see Field 5B.
W87-01979

INORGANIC NITROGEN UPTAKE BY EPILITHIC PERIPHYTON IN A N-DEFICIENT LAKE,
California Univ., Davis. Div. of Environmental Studies.
J. E. Reuter, S. L. Loeb, and C. R. Goldman.
Limnology and Oceanography LIOCAH, Vol. 31, No. 1, p 149-160, January 1986. 3 fig, 1 tab, 54 ref. NSF Grants DEB 78-23824, DEB-80-19918.

Descriptors: *Oligotrophic lakes, *Limnology, *Phytoplankton, *Nitrogen, *Carbon, *Periphyton, *Lake Tahoe, Cyanophyta, Nitrogen fixation, Ammonia, Nitrate, Michaelis-Menten kinetics, Seasonal distribution, Benthos, California, Nevada.

Seasonal patterns of dissolved inorganic N and inorganic C uptake by the sublittoral epilithic periphyton community in N-deficient, oligotrophic Lake Tahoe (California-Nevada) were examined. The biomass determinants of this community, N2-fixing blue-green algae, were persistent and retained their nitrogenase activity throughout the year. Seasonal rates of N2 fixation exhibited considerable variation, with a distinct summer maximum and winter minimum. Uptake of both NO3(-) and NH4(+) followed Michaelis-Menten kinetics. K sub t values were typically extremely high (> 100 microgram/l (ug/l) N) compared to the ambient concentrations of these forms of N (< 10 ug/l). N2 fixation was the most important source of inorganic N to the yearly N budget of this benthic community. Low ambient substrate concentrations coupled with low physiological affinity for these substrates at ambient levels were responsible for the relative unimportance of NO3(-) and NH4(+) uptake. Dark uptake of NO3(-), NH4(+), and N2 fixation all were significant and could not be neglected in determining rates of daily inorganic N utilization. This blue-green algal community is not adapted for efficient use of NO3(-) or NH4(+) and can survive in the N-deficient environment because of its abilty to use N2. In contrast, the phytoplankton of Lake Tahoe has no N2-fixing organisms and depends on NO3(-) and NH4(+) for N2 production. (Author's abstract)
W87-01980

BETA-3-DIMETHYLSULPHONIOPROPIONATE, PROLINE AND QUATERNARY AMMONIUM COMPOUNDS IN SPARTINA ANGLICA IN RELATION TO SODIUM CHLORIDE, NITROGEN AND SULPHUR,
Vrije Univ., Amsterdam (Netherlands). Dept. of Ecology and Ecotoxicology.
For primary bibliographic entry see Field 2I.
W87-02084

EFFECTS OF VASCULAR AND NONVASCULAR MACROPHYTES ON SEDIMENT REDOX AND SOLUTE DYNAMICS,
Notre Dame Univ., IN. Dept. of Biological Sciences.
M. L. Jaynes, and S. R. Carpenter.
Ecology ECOLAR, Vol. 67, No. 4, p 875-882, August 1986. 6 fig, 2 tab, 35 ref.

Descriptors: *Oxidation reduction potential, *Acidification, *Solutes, *Vascular tissues, *Macrophytes, *Lake sediments, Phosphorus, Iron, Hydrogen ion concentration, Mosses, Acidic water, Statistical analysis, Michigan.

Oxygen release by submerged vascular plant roots affects oxidation reduction (redox) related solute dynamics in lake sediments. Differences in pH, redox potential and phosphorus and iron fractions among sediments in a northern Michigan lake were found depending on whether they supported no vegetation, vascular macrophytes or moss. Redox potential and total phosphorus were higher and filterable phosphorus was lower at sites containing vascular plants. An in situ transplant experiment involving three different macrophytes and three sediment types showed that vascular plants raised sediment redox, lowered pH and filterable iron and phosphorus and enhanced sediment phosphorus retention. Sediments with transplanted moss were high in filterable iron and phosphorus, more of which was released to overlying water than was the case with sediments with vascular-plant transplants. During lake acidification, vegetation changes from tracheophytes to bryophytes could lower redox potential and increase iron and phosphorus mobility in sediments. (Author's abstract)
W87-02100

LUNAR CYCLE IN ZOOPLANKTON,
Warsaw Univ. (Poland). Dept. of Hydrobiology.
Z. M. Gliwicz.
Ecology ECOLAR, Vol. 67, No. 4, p 883-897, August 1986. 14 fig, 4 tab, 29 ref.

Descriptors: *Zooplankton, *Limnology, *Lunar cycle, *Life cycles, *Predation, Reservoirs, Seasonal variation, Zambezi River, Sampling, Fish diets, Feeding rates, Food chains, Fluctuations, Sardines, Population density, Population dynamics.

A zooplankton density cycle that was consistent with the moon phase was observed in a reservoir on the Zambezi River between 1982 and 1983. Densities of four cladoceran and two copepod species as determined from plankton net samples fluctuated over one order of magnitude. This pattern included an exponential increase in population density from the last quarter of the moon through the new moon and first quarter until the full moon when a sudden decrease was experienced in the last quarter. Higher death rates appeared to be caused by predation of the Tanganyikan sardine. This predator crops more efficiently on nights when a full moon rises after sunset or when zooplankton rise to the surface during darkness and are suddenly vulnerable in the first light of the rising moon. After the last quarter when the moon gives little light, the predators shift to alternate food sources and zooplankton populations grow exponentially. It is suggested that the moon phase cycle in zooplankton is a global phenomenon and that similar prey-predator reactions might be responsible for monthly rhythms in behavior and physiology of long life-span animals. (Author's abstract)
W87-02101

INFLUENCE OF HABITAT MANIPULATIONS ON INTERACTIONS BETWEEN CUTTHROAT TROUT AND INVERTEBRATE DRIFT,
Maryland Univ., Frostburg. Appalachian Environmental Lab.
M. A. Wilzbach, and K. W. Cummins.
Ecology ECOLAR, Vol. 67, No. 4, p 898-911, August 1986. 11 fig, 3 tab, 55 ref. NSF Grant BSR 811-24-55; DOE Contract DE-FG05-85EV60301.

Descriptors: *Aquatic habitats, *Trout, *Predation, *Forests, *Logging, *Invertebrates, Fish food, Fish populations, Feeding rates, Stream fisheries, Light penetration.

The influence of a logged vs. forested environment and prey availability on prey capture and growth of cutthroat trout was examined to determine if these variables affect the impact of trout predation on drift composition. Short-term growth rates of trout were greater in a logged portion than a forested section of stream. Differences in growth rates were attributed to differences in invertebrate drift density among stream pools and to foraging efficiency differences which were related to differences in the amount of overhead shading and substrate crevices. Mean percentages of introduced prey captured by trout were greater in logged control pools and pools where bottoms were covered with fiberglass screening to eliminate substrate crevices than in forested control pools and pools that were artificially shaded. A logrithmic relationship was found between foraging efficiency and surface light. Drift density increased in pools where trout were removed from the log reach, but not in the forested section. This may result from habitat features in the logged area that contribute to foraging success and the occurrence of behav-

iorally drifting prey which represent a predictable food supply for the trout. (Michael-PTT)
W87-02102

PHYSIOLOGICAL RESPONSES OF A NATIVE AND AN INTRODUCED DESERT FISH TO ENVIRONMENTAL STRESORS,
California Univ., Davis. Dept. of Wildlife and Fisheries Biology.
For primary bibliographic entry see Field 2E.
W87-02103

AREAS OF EVAPORATIVE DISCHARGE FROM AQUIFERS: LITTLE KNOWN SPANISH ECOSYSTEMS DESERVING PROTECTION,
Universidad Autonoma de Madrid (Spain). Dept. de Ecologia.
For primary bibliographic entry see Field 2F.
W87-02112

WETLAND VALUES AND PROTECTION STRATEGIES: A STUDY OF LANDOWNER ATTITUDES IN SOUTHERN ONTARIO,
Guelph Univ. (Ontario). Dept. of Geography.
For primary bibliographic entry see Field 6B.
W87-02116

WIND DRIVEN SURFACE TRANSPORT IN STRATIFIED CLOSED BASINS: DIRECT VERSUS RESIDUAL CIRCULATIONS,
Oregon State Univ., Corvallis. School of Oceanography.
P. T. Strub, and T. M. Powell.
Journal of Geophysical Research (C) JGRCEY, Vol. 91, No. 7, p 8497-8505, July 1986. 8 fig, 1 tab, 40 ref, append. NASA Grant NAG5-217.

Descriptors: *Lake basins, *Lake breezes, *Lake Tahoe, *Wind velocity, *Surface transport, *Circulation, Wave direction, Mathematical models, Mathematical equations, Wind waves, Water stress, Cyclones, Anticyclones.

The dynamics of wind-driven circulations in moderate-sized, stratified basins is investigated through numerical modeling of a variety of wind fields observed at Lake Tahoe. Direct and residual circulation characteristics of stratified and homogeneous basins are described. Previous studies of stratified closed basins have emphasized residual circulations that result in a single cyclonic mean gyre during light to moderate winds. Lake Tahoe observations have shown that currents are more constant in direction, with a double gyre pattern of surface circulation dominated by an anticyclonic northern gyre. Model experiments demonstrate that the curl of the wind stress must be included to obtain a direct double gyre circulation similar to observations. Horizontally uniform winds cause a residual circulation similar to that reported at other lakes. The model can be used to calculate the vorticity budget in order to clarify the role of wind stress curl in creating the direct double gyre. (Michael-PTT)
W87-02123

MODEL FOR PARTICLE-SELECTIVE TRANSPORT OF TRACERS IN SEDIMENTS WITH CONVEYOR BELT DEPOSIT FEEDERS,
National Oceanic and Atmospheric Administration, Ann Arbor, MI. Great Lakes Environmental Research Lab.
J. A. Robbins.
Journal of Geophysical Research (C) JGRCEY, Vol. 91, No. 7, p 8542-8558, July 1986. 14 fig, 1 tab, 73 ref.

Descriptors: *Bottom sediments, *Bioturbation, *Bottom water, *Microorganisms, *Isotopic tracers, *Deposition, *Selectivity, Mathematical models, Mathematical equations, Particle diffusion, Benthos, Benthic fauna, Advection, Fluctuations, Feeding effects, Lead radioisotopes.

Conveyor belt feeders are bottom-dwelling organisms that have profound effects on sediment structure. A quantitative model of the effects of particle-selective conveyor belt deposit feeders in two-phase sediment systems where reaction terms are restricted to simple linear adsorption and radioactive decay is presented. The ingestion rate of sediment particles and pore water is characterized by a first-order rate constant with depth dependence having a Gaussian (localized feeding) or integrated Gaussian (distributed feeding) form. Feeding distributions are based on particle tracer experiments with laboratory microorganisms. Particle selectivity is incorporated by treating tracer transfer separately from transfer of bulk sediment. It is assumed that tracer and bulk sediment are deposited only on the surface. Properties of the model are illustrated for tracers in nondispersive systems that are strongly bound to sediment solids. Conveyor belt recycling causes transient reflections on tracer pulse passage through the bioturbation zone, but these reflections disappear in the presence of various integrative processes. A simple expression is developed for estimating the magnitude of particle-selection changes in surface concentrations in terms of selectivity and sediment rework efficiency. When applied to previous studies of conveyor belt feeders, this model demonstrates the need to include particle diffusion as well as advection in the treatment of conveyor belt transport processes. (Michael-PTT)
W87-02124

MODELING RADIOTRACERS IN SEDIMENTS: COMPARISON WITH OBSERVATIONS IN LAKE HURON AND MICHIGAN,
Wisconsin Univ.-Milwaukee. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2J.
W87-02125

RESONANT SLOSHING IN SHALLOW WATER,
Oxford Univ. (England). Mathematical Inst.
For primary bibliographic entry see Field 8B.
W87-02130

EFFECT OF NUTRIENTS ON SHOOT BIOMASS AND SPECIES COMPOSITION OF WETLAND AND HAYFIELD COMMUNITIES,
Utrecht Rijksuniversiteit (Netherlands). Dept. of Plant Ecology.
For primary bibliographic entry see Field 5C.
W87-02135

USE OF DISPOSABLE CLEAN-UP COLUMNS FOR SELECTIVE REMOVAL OF HUMIC SUBSTANCES PRIOR TO MEASUREMENTS WITH A NITRATE ION-SELECTIVE ELECTRODE,
Lund Univ. (Sweden). Dept. of Analytical Chemistry.
For primary bibliographic entry see Field 5A.
W87-02167

REJUVENATION OF MELOSIRA GRANULATA (BACILLARIOPHYCEAE) RESTING CELLS FROM THE ANOXIC SEDIMENTS OF DOUGLAS LAKE, MICHIGAN. I. LIGHT MICROSCOPY AND 14C UPTAKE,
Michigan Univ., Ann Arbor. Great Lakes Research Div.
L. Sicko-Goad, E. F. Stoermer, and G. Fahnenstiel.
Journal of Phycology JPYLAJ, Vol. 22, No. 1, p 22-28, March 1986. 3 tab, 9 fig, 50 ref. NSF Grant OCE 83-09142.

Descriptors: *Rejuvenation, *Limnology, *Diatoms, *Anoxic sediments, *Carbon-14 uptake, *Douglas Lake, *Michigan, *Algae, *Light microscopy, Chrysophyta, Carbon isotopes, Diatoms, Melosira, Resting cells.

Resting cells of Melosira granulata (Ehr.) Ralfs were collected from the anoxic sediments of Douglas Lake, Michigan. Sediments containing M. granulata were inoculated into distilled water and incubated in a growth chamber for one week for cytological differentiation processes. Cells classified as condensed, i.e. containing a dark brown cytoplasmic mass were identified as resting cells. The differentiation process consisted of a series of gradual cytological changes. Differentiation cells accumulated large polyphosphate and lipid granules. These granules disappeared just prior to cell division. Not all dormant cells rejuvenated at the same time and it was observed that the lag period for rejuvenation increased with resting cell age (depth of burial in sediments). In the 14C uptake studies, label was initially observed in condensed state cells. The label gradually progressed to the more differentiated forms. Total carbon uptake during the rejuvenation process was initally lower in the rejuvenating cells, but roughly equal to water column populations after 8 h, indicating a period of high metabolic activity in the rejuvenating cells between 1 and 8 h. (See also W87-02169) (Author's abstract)
W87-02168

REJUVENATION OF MELOSIRA GRANULATA (BACILLARIOPHYCEAE) RESTING CELLS FROM THE ANOXIC SEDIMENTS OF DOUGLAS LAKE, MICHIGAN. II. ELECTRON MICROSCOPY,
Michigan Univ., Ann Arbor. Great Lakes Research Div.
L. Sicko-Goad.
Journal of Phycology JPYLAJ, Vol. 22, No. 1, p 28-35, March 1986. 12 fig, 22 ref. NSF Grant OCE 83-09142.

Descriptors: *Sediments, *Anoxic sediments, *Diatoms, *Limnology, *Electron microscopy, *Douglas Lake, *Michigan, *Resting cells, *Algae, Diatom ultrastructure, Melosira, Rejuvenation.

Detailed cytological changes that accompany the rejuvenation of resting cells of Melosira granulata were studied with the electron microscope. Dormant and viable cells generally contain definable chloroplasts, mitochondria, a nucleus and other cytoplasmic remnants. However, there is a continuous cytoplasmic degradation spectrum and some cells which appear intensely colored with the light microscope have discontinuous chloroplast membranes and few other cytoplasmic remnants. Rejuvenation of viable dormant cells was initially accompanied by the accumulation of both lipids and polyphosphates. In the earliest stages of expansion, these storage products are dispersed throughout the cell, while in the later stages the lipids appear to be coalesced into larger droplets which are easily identified at the light microscope level. The fully expanded stage is characterized by the normal complement of organelles and their arrangement at the periphery of the cells and central cytoplasmic bridge. These cells appear both anabolically and catabolically active. Prior to cell division, both lipids and polyphosphates are reduced or absent in the cells. A rejuvenation sequence that produces cytological features common to resting state formation could provide a population of cells which could easily revert should environmental conditions become adverse. (See also W87-02168) (Author's abstract)
W87-02169

DESCRIPTIVE AND ULTRASTRUCTURAL STUDY OF THE GREEN ALGA, CHLAMYDOMONAS DESMIDII SP. NOV. (VOLVOCALES, CHLAMYDOMONADACEAE), FROM ROCKY MOUNTAIN NATIONAL PARK LAKES,
Colorado State Univ., Fort Collins. Dept. of Botany and Plant Pathology.
P. Kugrens, and S. G. Delivopoulos.
Journal of Phycology JPYLAJ, Vol. 22, No. 1, p 71-78, March 1986. 25 fig, 19 ref.

Descriptors: *Green algae, *Algae, *Limnology, *Ultrastructure, *Volvocales, *Flagellates, Lakes, Dinoflagellates, Flagellate structures, Rocky Mountain National Park Lakes.

The green algal flagellate Chlamydomonas desmidii sp. nov., is described from several lakes in Rocky Mountain National Park, Colorado. The biflagellate cells generally have an hour-glass shape with a single chloroplast with two pyrenoids and a superficial stigma near the center of the cell. Numerous contractile vacuoles occur in the peripheral cytoplasm and they are arranged in sever-

al rings around the nucleus in the restricted region of the cell. Ultrstructural studies verify these features and elaborate upon the structure of the cell. C. desmidii is not an obligate cryophile and grows just as well at 16-18 C as it does at temperatures below 5 C. Most of the Colorado algae collected for this study exhibited a wide range of temperature tolerances. Increased growth in winter appeared to be due to sufficient light penetration through the ice. Thus more studies should be focused on the winter aspects of phytoplankton ecology. (Khumbatta-PTT)
W87-02170

DECOMPOSITION OF LAKE PHYTOPLANKTON. 1. DYNAMICS OF SHORT-TERM DECOMPOSITION,
L. Hansen, G. F. Krog, and M. Sondergaard.
Oikos OIKSAA, Vol. 46, No. 1, p 37-44, February 1986. 2 fig, 2 tab, 21 ref.

Descriptors: *Phytoplankton, *Limnology, *Lakes, *Decomposition, Denmark, Carbon isotopes, Plankton, Lysis, Algae, Leaching.

Long-term (4-6 days) and short-term (24 hours) decomposition of phytoplankton cells were investigated under in situ conditions in four Danish lakes. Carbon-14-labelled, dead algae were exposed to sterile or natural lakewater and the dynamics of cell lysis and bacterial utilization of the leached products were followed. The lysis process was dominated by an initial fast water extraction, with 4 to 34% of the labelled carbon leached from the algal cells within 2 to 4 hours. 11 to 43% of the initial particulate carbon was found as dissolved carbon after 24 hours and after 4 to 6 days, the leaching was from 67 to 78% of the initial carbon-14. The leached compounds were utilized by bacteria and a mean of 71% of the lysis products were metabolized by microorganisms within 24 hours. In two experiments, the uptake rate equaled the leaching rate. (See also W87-02172) (Author's abstract)
W87-02171

DECOMPOSITION OF LAKE PHYTOPLANKTON. 2. COMPOSITION AND LABILITY OF LYSIS PRODUCTS,
G. F. Krog, L. Hansen, and M. Sondergaard.
Oikos OIKSSA, Vol. 46, No. 1, p 45-50, February 1986. 2 fig, 2 tab, 16 ref.

Descriptors: *Phytoplankton, *Lysis products, *Algae, *Lakes, *Limnology, *Decomposition, Plankton, Degradation, Pollution, Lability, Leaching, Denmark.

The lysis process of phytoplankton was followed in 24 hour incubations in three Danish lakes. The dissolved carbon leaching from different algal groups differed in molecular weight compositions. Three distinct molecular weight classes(>10,000;700 to 10,000 and <700 Daltons) were leached from blue-green algae in almost equal proportions. Spring-bloom diatoms had lysis products in only the two smaller sizes, and the molecules between 700 and 10,000 Daltons dominated. Measurements of cell content revealed polysaccharides and low molecular weight compounds to dominate the lysis products. No proteins were leached the first 24 hours after cell death. Detection of high bacterial affinity towards molecules between 700 and 10,000 Daltons was possible by incubation of the dead algae in natural lake water. Bacterial transformation of small molecules to larger molecules could also be demonstrated. (See also W87-02171) (Author's abstract)
W87-02172

SEASONAL VARIABILITY AND GEOCHEMICAL SIGNIFICANCE OF ORGANIC MATTER IN THE RIVER GANGES, BANGLADESH,
Hamburg Univ. (Germany, F.R.). Inst. of Geology and Paleontology.
For primary bibliographic entry see Field 2J.
W87-02176

EFFECTS OF INCREASING SALINITY ON AN ARTEMIA POPULATION FROM MONO LAKE, CALIFORNIA,
California Univ., Santa Barbara. Marine Science Inst.
G. L. Dana, and P. H. Lenz.
Oecologia OECOBX, Vol. 68, No. 3, p 428-436, February 1986. 8 fig, 3 tab, 47 ref.

Descriptors: *Artemia, *Limnology, *Salinity, *Mono Lake, *California, Total dissolved solids, Macrozooplankton, Plankton, Lakes.

Salinity increased from 48 to 93 g/l total dissolved solids (TDS) in Mono Lake, California, between 1941 and 1982 and is expected to fluctuate between 169 and 248 g/l at equilibrium by the middle of the next century. Effects of salinity on survival, growth, reproduction and hatching of Artemia monica were determined, Mono Lake's only macrozooplakton species. The salt tolerance limit for subadult A. monica was between 159 and 179 g/l. Adult size, growth rates and brood sizes decreased and female mortality during reproduction increased with increasing salinity. Hatching of diapause eggs was delayed and total percent hatch decreased as salinity increased, with hatching failing at 159 g/l. The life-time reproductive potential of individuals decreased linearly over the seven salinities tested. A decrease in the productivity of the A. monica population is predicted and even extinction is possible with nearly equilibrated salinities. (Author's abstract)
W87-02180

RELATIVE SALT TOLERANCE OF CAKILE EDENTULA (BRASSICACEAE) FROM LACUSTRINE AND MARINE BEACHES,
California Univ., Davis. Dept. of Botany.
For primary bibliographic entry see Field 2I.
W87-02182

PRECISION OF A FIELD METHOD FOR DETERMINATION OF PH IN DILUTE LAKES,
Geological Survey, Lakewood, CO. Water Resources Div.
For primary bibliographic entry see Field 5A.
W87-02186

DENSITY STRATIFICATION IN IONICALLY ENRICHED ONONDAGA LAKE, U.S.A.,
Upstate Freshwater Inst., Inc., Syracuse, NY.
For primary bibliographic entry see Field 5C.
W87-02187

BASE NEUTRALIZING CAPACITY OF SEDIMENTS FROM AN ACIDIC LAKE,
Booth Aquatic Research Group, Inc., Toronto (Ontario).
L. A. Molot.
Water, Air, and Soil Pollution, Vol. 27, No. 3/4, p 297-304, 1986. 4 tab, 20 ref.

Descriptors: *Base neutralizing, *Sediments, *Acidic lakes, Bowland Lake, Sediment cores, Radiolabeling, Radiometer, pH meter.

The base neturalizing capacity (BNC) of acidic lake sediments may influence the amount of neutralizing agent required to neutralize a lake if the sediment BNC is large relative to the BNC of overlying waters. The extent of in situ sediment BNC in acidic Bowland Lake was inferred by measuring the loss of Ca-45 to acidic sediments from labeled lake water neutralized with CaCO3, and measuring exchangeable Ca in sediments collected prior to and following neutralization of Bowland lake with calcite. The BNC derived from Ca-45 radiolabeling experiment was 0.01 mg CaCO3/g w wt. The mean losses of Ca-45 from the aqueous phase of neutralized and untreated sediment/water mixtures were not significantly different. The mean pH of both neutralized an untreated mixtures decreased to 4.0 during incubation. Sediment BNC estimates derived from literature data may be overestimated because of the inclusion of anoxic sediments containing significant amounts of reduced Fe. There was no significant difference in exchangable Ca between sediment from untreated Bowland Lake and sediments collected 10 m after whole-lake neutralization indicating that little of the supplied alkalinity had been lost to the sediments. Hence, in situ sediment BNC was probably small in Bowland Lake. (Author's abstract)
W87-02190

CHANGES IN LIGHT ATTENUATION DURING FILLING, STABILIZATION AND OPERATION OF A RESERVOIR,
Upstate Freshwater Inst., Inc., Syracuse, NY.
S. W. Effler, and F. B. Trama.
Water, Air, and Soil Pollution WAPLAC, Vol. 28, No. 1/2, p 27-37, 1986. 4 fig, 3 tab, 27 ref.

Descriptors: *Light attenuation, *Reservoirs, Plankton, Secchi disc transparency, Chlorophyll a, Adsorption, Scattering, Downwelling irradiance, Flow-augumentation releases, Water storage.

Transformation in light attenuation (Kd) and Secchi disc transparency (SD) in Round Valley Reservoir, New Jersey, are, documented over a 17 yr period (1966-1983). Attenuation was partitioned empirically, according to contributions from chlorophyll a and non-phytoplanktonic components, and mechanistically, according to contributions from the processes of adsorption and scattering. Pertinent measurement included downwelling irradiance, SD, and chlorophyll a. Light attenuation levels were high during the first year of filling, but dropped substantially by the second year of filling. Further major reductions in K sub d were observed following the transition phase. Average S sub D values for 1966, 1967, and following the transition phase were 1.4, 3.2, and 7.3 m, repectively. Throughout these major changes the relative contributions of absorption and scattering to attenuation remained essentially uniform. Chlorophyll a explained a significant portion of the observed variability in K sub d over the monitored period. However, different regimes of attenuation were apparent. Refilling of the reservoir following flow-augmentation releases resulted in increases in K sub d, associated with increases of non-phytoplanktonic attentuating materials. The increase in K sub d caused the development of increased density gradients in the metalimnion of the reservoir during mid-summer, and probably thereby reduced vertical mixing. (Author's abstract)
W87-02196

ALGAL BLOOMS: CONSEQUENCES AND POTENTIAL CURES,
Dundee Univ. (Scotland). Dept. of Biological Sciences.
For primary bibliographic entry see Field 5C.
W87-02218

WIND-WAVE PREDICTION,
California Univ., Berkeley. Dept. of Civil Engineering.
For primary bibliographic entry see Field 8B.
W87-02225

ENERGY BUDGET FOR THE ZOOBENTHOS OF MIRROR LAKE, NEW HAMPSHIRE,
New York Botanical Garden, Bronx, NY. Inst. of Ecosystem Studies.
D. Strayer, and G. E. Likens.
Ecology ECOLAR, Vol. 67, No. 2, p 303-313, April 1986. 2 fig, 4 tab, 90 ref, 1 append.

Descriptors: *Energy flow models, *Assimilation, *Benthic algae, *Biomass, *Limnology, *Mathematical models, *Aquatic productivity, *Predation, Littoral zone, Diets, Lakes, Energy, Benthos, Oligotrophic lakes, New Hampshire, Mirror Lake.

As part of a comprehensive study of the entire metazoan benthos of Mirror Lake, New Hampshire an energy budget of the entire lake community was constructed by indirect means. The analysis is directed at three basic, questions: (1) what sources of energy support the zoobenthos, (2) what is, the fate of zoobenthic production, and (3) how important is the meiofauna, in zoobenthic energe-

tics. Because the analysis is indirect and involves, several approximations and assumptions, the numerical results are, approximate and must be interpreted cautiously. The results are sufficiently robust to support several broad conclusions about energy flow in the zoobenthos that should be of general interest to ecologists. Data on abundance, biomass, and diet of benthic animals were combined with, estimates of annual production/biomass ratios to construct a model of energy flow through the zoobenthos of this small, oligotrophic lake. Because the meiofauna are included, the model provides the first accounting of energy flow through an entire zoobenthic community in freshwater. About, half of the zoobenthic assimilation of carbon is due to the meiofauna, Although detritivory supports about half of community assimilation, benthic algae are an important energy source to the zoobenthos, especially in the littoral zone. This suggests the importance of benthic algae in lacustrine energy budgets has been underestimated. Major fates of zoobenthic production in Mirror Lake include invertebrate predation, insect emergence and fish predation. Invertebrate predation is the dominant fate, and accounts for 80% of zoobenthic production. (McFarlane-PTT)
W87-02228

RELATIONSHIP BETWEEN NUTRIENTS, DOMINANT IONS, AND PHYTOPLANKTON STANDING CROP IN PRAIRIE SALINE LAKES,
Alberta Univ., Edmonton. Dept. of Zoology.
J. F. H. Bierhuizen, and E. E. Prepas.
Canadian Journal of Fisheries and Aquatic Sciences CJFSBX, Vol. 42, No. 10, p 1588-1594, October 1985. 3 fig, 5 tab, 39 ref.

Descriptors: *Nutrients, *Limnology, *Ions, *Phytoplankton, *Saline lakes, Salinity, Alberta, Canada, Chemical properties, Chlorophyll a, Phosphorus, Nitrogen, Model studies, Prediction, Conductivity, Dissolved solids, Sodium ions, Biomass.

The relationship between salinity, nutrients and phytoplankton standing crop in samples from 20 inland saline lakes in Alberta, Canada was evaluated. Chemical characteristics of those lakes with similar ionic composition were tested for significant correlations of chlorophyll a (Chl a). The relationship between total phosphorus (TP) and total nitrogen (TN) and Chl a in saline lakes was compared with empirical models developed for freshwater lakes to determine whether the relationship between Chl a and nutrients in saline lakes was different than that in freshwater lakes. There was a significant positive relationship between TP and Chl a in saline lakes with TN to TP ratios greater than 12 (by weight). In these cases, deviations between Chl a levels predicted from the models and observed levels were positively correlated with conductivity, total dissolved solids and sodium ions. The deviation of phytoplankton biomass from that predicted by the models was attributed to conductivity or dominant ion concentration. (Michael-PTT)
W87-02246

EFFECTS OF ABUNDANCE AND WATER TEMPERATURE ON RECRUITMENT AND GROWTH OF ALEWIFE (ALOSA PSEUDOHARENGUS) NEAR SOUTH BAY, LAKE HURON, 1954-82,
Ontario Ministry of Natural Resources, Toronto. Lake Huron Fisheries Research Unit.
B. A. Henderson, and E. H. Brown, Jr.
Canadian Journal of Fisheries and Aquatic Sciences CJFSBX, Vol. 42, No. 10, p 1608-1613, October 1985. 1 fig, 4 tab, 23 ref.

Descriptors: *Alewife, *Water temperature, *Lake Huron, Fish populations, Growth, Recruitment, Fish food, Temperature effects.

Four hypotheses on the effects of stock size and water temperature on growth and recruitment were statistically tested on samples of alewives spawning in South Bay, Lake Huron between 1954 and 1982. The number of recruits per spawner was not a function of parental stock size, but depended on surface water temperatures in June and July. Although the size of both males and females at age three years was positively related to surface-water temperatures in the three preceding summers, growth rates were a function of water temperatures only during the second year of growth. Growth rates during the first three years of growth were all related to year-class strength. Population abundance through recruitment appeared to be affected by water temperature, while growth was mostly affected through intraspecific competition for food. (Michael-PTT)
W87-02247

COMPARISON OF SUMMER AND WINTER OXYGEN CONSUMPTION RATES IN A TEMPERATE DIMICTIC LAKE,
Trent Univ., Peterborough (Ontario). Dept. of Biology.
G. A. Linsey, and D. C. Lasenby.
Canadian Journal of Fisheries and Aquatic Sciences CJFSBX, Vol. 42, No. 10, p 1634-1639, October 1985. 5 fig, 4 tab, 24 ref.

Descriptors: *Limnology, *Oxygen requirements, *Dimictic lakes, *Seasonal variation, *Temperature effects, Oxygen demand, Oxygen depletion, Ontario, Hypolimnion, Rainfall impact, Water sampling.

The winter rate of oxygen loss as determined from oxygen profiles differed significantly from the hypolimnetic rate in a temperate dimictic lake in southern Ontario. Sediment oxygen demand (SOD) and water column oxygen demand (WOD) did not significantly change. In summer, the sum of SOD and WOD closely approximated the hypolimnetic deficit, but in winter, SOD plus WOD overestimated the observed oxygen consumption rate. Measurement of primary production and an estimate of rainwater influx demonstrated that both could be significant sources of oxygen input during winter. Although both SOD and WOD were found to vary significantly between sampling sites, a central station yielded mean seasonal values that closely approximated those obtained by combining data from all stations. (Michael-PTT)
W87-02248

SHORT-TERM EFFECT ON THE METABOLISM OF LOTIC BENTHIC COMMUNITIES FOLLOWING EXPERIMENTAL ACIDIFICATION,
Laval Univ., Quebec. Dept. de Biologie.
For primary bibliographic entry see Field 5C.
W87-02249

SELENIUM REQUIREMENT OF A BLOOM-FORMING PLANKTONIC ALGA FROM SOFTWATER AND ACIDIFIED LAKES,
University of Western Ontario, London. Dept. of Plant Sciences.
For primary bibliographic entry see Field 5C.
W87-02252

SPRING MELTWATER MIXING IN SMALL ARCTIC LAKES,
Manitoba Univ., Winnipeg. Dept. of Zoology.
M. A. Bergmann., and H. E. Welch.
Canadian Journal of Fisheries and Aquatic Sciences CJFSBX, Vol. 42, No. 11, p 1789-1798, November 1985. 10 fig, 3 tab, 21 ref.

Descriptors: *Arctic lakes, *Snowmelt, *Mixing, Lake ice, Ice cover, Ice thickness, Ice-water interfaces, Seasonal variation, Tritium, Dye releases, Water circulation, Model studies, Tracers.

The applicability of theoretical lake water turnover times to the modeling of ice-covered lakes was evaluated in a study of meltwater mixing in small arctic lakes. Two tritium additions were made, one of which was mixed with unfrozen lake water at the time of maximum lake ice thickness, and the other of which was mixed with the lake immediately after freezing. Dye experiments were also performed to define the spatial and temporal distribution of the inflow and icemelt layers. Results of tritiated water and dye addition and profiles of conductance and temperature showed that during ice-on, low-density meltwater floated in a thin layer under the ice, extended over the entire subice-surface area and left the lake without mixing with the heavier subice water. These results indicate that lake models that incorporate a lake flushing rate term should be modified to accommodate the lack of meltwater mixing beneath spring ice and that more attention be given to early spring meltwater chemistry and its distribution within the upper lake strata. (Michael-PTT)
W87-02253

SPECIES-SPECIFIC EFFECTS OF SUBLETHAL CONCENTRATIONS OF CADMIUM ON FRESHWATER PHYTOPLANKTON COMMUNITIES IN A CANADIAN SHIELD LAKE,
Kansas State Biological Survey, Lawrence.
For primary bibliographic entry see Field 5C.
W87-02258

GROWTH AND BIOMASS ALLOCATION OF RUPPIA OCCIDENTALIS IN THREE LAKES DIFFERING IN SALINITY,
Alberta Univ., Edmonton. Dept. of Botany.
B. C. Husband, and M. Hickman.
Canadian Journal of Botany CJBOAW, Vol. 63, No. 11, p 2004-2014, November 1985. 14 fig, 8 tab, 44 ref. NSERC (Canada) A6384.

Descriptors: *Biomass, *Limnology, *Saline lakes, *Ruppia occidentalis, Plant growth, Plant tissues, Salinity, Salt tolerance, Dissolved solids.

Growth and biomass accumulation in populations of Ruppia occidentalis from three Alberta lakes spanning a wide range of total dissolved solids were compared to evaluate the hypothesis that growth and distribution increases with the degree of salinity. Growth and biomass allocation of individuals were correlated with lake chemistry. Plants from the freshwater lake exhibited characteristics associated with moderate chemical deficiency. The proportion of total dry weight decreased in roots and increased in shoots with salinity, but varied little among lake depths. Changes in dry shoot weight resulted from vertical growth in the saline lakes, but were caused by horizontal growth through tiller production in the freshwater lake. The number of flowering individuals in the population increased with salinity. The frequency of occurence and percentage of Ruppia coverage within each lake reflected its respective growth rate and reproduction. Ruppia distributions were characterized by interactions between salinity and depth distribution and substratum type. Saline conditions are required by Ruppia for maximum growth and reproduction. Its absence from many freshwater lakes is due most likely to chemical constraints on survival or on the competitive ability of Ruppia. (Michael-PTT)
W87-02259

UNCERTAINTY IN PHOSPHORUS RETENTION, WILLIAMS FORK RESERVOIR, COLORADO,
Geological Survey, Denver, CO.
J. W. LaBaugh.
Water Resources Research WRERAO, Vol. 21, No. 11, p 1684-1692, November 1985. 5 fig, 1 tab, 27 ref.

Descriptors: *Phosphorus, *Fate of pollutants, *Water budget, *Retention, *Reservoirs, *Colorado, Mathematical equations, Mathematical models, Statistical analysis, Prediction.

Uncertainties in the calculation of water and phosphorus budgets were modeled to show their effect on the interpretation of phosphorous retention data for a bottom-withdrawal reservoir. Ungaged components of the water budget were estimated from the residual of measured terms. The residual accounted for $<30\%$ of total water input and for $>45\%$ of total phosphorus input in each year of the three year study. Uncertainty in phosphorus retention data was largely because of uncertainty in the total phosphorus input due to use of a residual term. (Author's abstract)
W87-02281

OPTICAL PROPERTIES OF NEW ZEALAND LAKES: II. UNDERWATER SPECTRAL CHARACTERISTICS AND EFFECTS ON PAR ATTENTUATION,

Department of Scientific and Industrial Research, Taupo (New Zealand). Div. of Marine and Freshwater Sciences.
C. Howard-Williams, and W. F. Vincent.

Archiv fuer Hydrobiologie AHYBAY, Vol. 104, No. 4, p 441-457, October 1985. 4 fig, 4 tab, 31 ref.

Descriptors: *Limnology, *New Zealand, *Lakes, *Optical properties, Spectral analysis, Photosynthesis, Radiation, Dissolved solids, Water depth, Light intensity, Light absorbance, Model studies.

The underwater penetration of photosynthetically available radiation (PAR) within discrete wavebands was measured in 34 New Zealand lakes with a quantum irradiance sensor fitted with various color filters. The field data were used to derive the waveband specific absorption coefficients for a range of lake types. These were subsequently partitioned into absorption components due to dissolved organic matter (obtained by spectrophotometry), water and seston. Most lakes showed a spectral shift in PAR with depth, but the geothermal lakes examined were anomalous both in their field spectral characteristics and laboratory absorbance spectra. The depth dependence of diffuse attenuation coefficient (k sub d) for full spectrum PAR is illustrated with a simple conceptual model. The rate of decline of K sub d to K sub alpha (the measured minimum extinction coefficient for PAR) with depth varied considerably between broad lake categories. These data re-emphasize the problems associated with apparent optical properties (such as K sub d) in the analysis of specific light absorbing components. (Author's abstract)
W87-02309

AVAILABILITY OF PHOSPHORUS UPWELLING FROM IRON-RICH ANOXIC HYPOLIMNIA,

McGill Univ., Montreal (Quebec). Dept. of Biology.
G. K. Nurnberg.

Archiv fuer Hydrobiologie AHYBAY, Vol. 104, No. 4, p 459-476, October 1985. 9 fig, 3 tab, 26 ref.

Descriptors: *Limnology, *Phosphorus, *Upwelling, *Hypolimnion, *Lake Magog, *Quebec, Thermocline, Thermal stratification, Nitrogen, Nutrient cycling, Phytoplankton, Bioassay.

It is hypothesized that the biological availability of phosphorus from anoxic, iron-rich hypolimnia after mixing with aerated surface water is high. During stratification in Lake Magog, Quebec, slow thermocline erosion begins to fertilize the trophogenic zone with the upwelling phosphorus, as suggested by a decreased N:P ratio, decreased rates of phosphate uptake, increased soluble reactive phosphorus (SRP) and total phosphorus concentrations. At fall turnover, rapid thermocline erosion results in significant increases in SRP, particulate reactive phosphorus, biological particulate phosphorus and total phosphorus. The fall mass balance of Lake Magog indicates that, despite high iron concentrations in the hypolimnion, at most 30% of hypolimnetic phosphorus formed an iron-phosphorus complex, while 30% was incorporated into plankton and 30% stayed as SRP. Bioassays showed that 55-85% of the surface SRP is bioavailable. Laboratory studies suggest that, in iron-rich lakes where the hypolimnetic water is greatly diluted, up to 90% of hypolimnetic phosphorus can be available to the plankton. (Author's abstract)
W87-02310

PHASED CELL DIVISION AND GROWTH RATE OF A PLANKTONIC DINOFLAGELLATE, CERATIUM HIRUNDINELLA, IN RELATION TO ENVIRONMENTAL VARIABLES,

Tennessee Univ., Knoxville. Dept. of Ecology.
M. M. Elser, and W. O. Smith.

Archiv fuer Hydrobiologie AHYBAY, Vol. 104, No. 4, p 477-491, October 1985. 5 fig, 3 tab, 43 ref.

Descriptors: *Plankton, *Population dynamics, *Dinoflagellates, *Lambert Quarry, *Tennessee, Ceratium hirundinella, Oak Ridge, Water depth, Temperature, Microbiological studies, Chlorophyll, Light intensity, Growth.

Growth rates and the timing of cellular division of Ceratium hirundinella populations in Lambert Quarry, a small quarry lake near Oak Ridge, Tennessee, were investigated to relate population growth to environmental variables. Ceratium growth rates were calculated from counts of binucleated, recently divided and non-divided cells in samples taken from discrete depths within the water column over 24-hr periods. Maximum frequency of binucleated cells occurred at 2.00 hr; approximately 4 to 10% of the population divided each day. Doubling times calculated from these observations ranged from 7 to 15 days and closely corresponded to estimates of growth rates based on C-14 assimilation. Vertical profiles of cell numbers suggested that C. hirundinella migrated vertically, although the quantitative variations in chlorophyll were not large. Light intensity appeared to be the most important environmental factor governing C. hirundinella growth, although temperature and nutrient availability may also have played important roles. (Author's abstract)
W87-02311

PEG-MODEL OF SEASONAL SUCCESSION OF PLANKTONIC EVENTS IN FRESH WATERS,

Max-Planck-Inst. fuer Limnologie zu Ploen (Germany, F.R.).
U. Sommer, Z. M. Gliwicz, W. Lampert, and A. Duncan.

Archiv fuer Hydrobiologie AHYBAY, Vol. 106, No. 4, p 433-471, June 1986. 7 fig, 1 tab, 193 ref.

Descriptors: *Plankton, *Seasonal events, *Limnology, *Lakes, *Model studies, Phytoplankton, Zooplankton, Lake Constance, Reservoirs, Ponds, Algae, Biomass, Eutrophic lakes, Oligotrophic lakes.

A model is proposed which consists of 24 sequential statements which describe step by step the seasonal events which occur in the phytoplankton and zooplankton of an idealized 'standard' lake, based upon the well-studied Lake Constance. These statements have been confronted with the real situations which exist in 24 different lakes, reservoirs and ponds which have been extensively studied. The confrontation of the model with empirical data reveals a major dichotomy in the successional pathways which occur in lakes with and without elevated levels of summer algal biomass. This dichotomy together with other significant features, such as the extent of grazing pressure, are compared with the traditional distinction of water bodies into trophic types (eutrophic, oligotrophic). Succession in plankton is understood to be predictable and directional although it may be disturbed by irregular physical events. (Author's abstract)
W87-02331

GREEN, BLUEGREEN AND DIATOM ALGAE: TAXONOMIC DIFFERENCES IN COMPETITIVE ABILITY FOR PHOSPHORUS, SILICON AND NITROGEN,

Minnesota Univ., Minneapolis. Dept. of Ecology and Behavioral Biology.
D. Tilman, R. Kiesling, R. Sterner, S. S. Kilham, and F. A. Johnson.

Archiv fuer Hydrobiologie AHYBAY, Vol. 106, No. 4, p 473-485, June 1986. 2 fig, 1 tab, 32 ref. NSF Grants DEB 79-04250 and OCE 78-27016.

Descriptors: *Chlorophyta, *Limnology, *Diatoms, *Algae, *Lake Michigan, *Lake Superior, *Eau Galle Reservoir, Wisconsin, Taxonomy, Phosphorus, Silicon, Nitrogen, Algal growth, Temperature, Nutrients.

Phytoplankton communities from Lake Superior, Lake Michigan, and Eau Galle Reservoir, Wisconsin, were subjected to a range of supply ratios of two potentially limiting resources. The resultant gradients in resource availability produced consistent results between the three independent research efforts. In all cases, diatoms were superior competitors under phosphorus limitation with green and bluegreen algae dominant under nitrogen limitation. The dominance of these major taxa in relation to Si:P and N:P supply ratios was temperature dependent. Diatoms dominated a broader range of nutrient conditions below 14 C. Green and bluegreen algae were dominant in flasks with moderate to low Si:P and N:P supply rates, and dominated a wider range of supply ratios at higher temperatures (17 C and 24 C). These relationships support the hypothesis that temperature-dependent resource competition may be an important process structuring natural algal communities. They could explain the shift to dominance by bluegreen and green algae in mid-latitude, mildly-productive phosphorus-limited lakes with culturally derived phosphorus additions and warming. (Lantz-PTT)
W87-02332

SEASONAL AND AREAL DIFFERENCES IN THE THYROID HISTOLOGY OF THE VENDACE (COREGONUS ALBULA L.) IN FRESH AND BRACKISH WATERS IN FINLAND,

Kuopio Univ. (Finland). Dept. of Applied Zoology.

For primary bibliographic entry see Field 5C.
W87-02333

COMMERCIAL FISH CATCHES AS AN INDEX OF LAKE EUTROPHICATION,

Instytut Rybactwa Srodladowego, Olsztyn-Kortowo (Poland).
M. Leopold, M. Bninska, and W. Nowak.

Archiv fuer Hydrobiologie AHYBAY, Vol. 106, No. 4, p 513-524, June 1986. 2 fig, 1 tab, 17 ref.

Descriptors: *Eutrophication, *Fish harvest, *Lakes, Time series analysis, Graphical analysis, Mathematical analysis, Statistical analysis, Fisheries, Fish management, Water quality control.

Analysis of the trends in fish catches unequivocally shows that it is fully possible to determine the rate of a eutrophication process in lakes, even in a macroscale, on the basis of time series approach, with fish catches approximated by parabolic curves. Convergence between real and calculated (theoretical) values is very good and highly significant statistically. The proposed method of analysis allows for determining the regularities in species succession induced by lake eutrophication, and for finding which phenomena are not directly connected with this process, but with other impacts upon the aquatic environment, both negative and positive. Moreover, the adopted approach allows not only for the presentation of the changes which have already taken place in the past, but also for predicting future trends, the latter aspect being of considerable practical importance. Furthermore, this method of analysis is of an instrumental character, and can be used for assessing the efficiency of fishery management. (Lantz-PTT)
W87-02335

EXPERIMENTAL STUDIES TO THE AUTOECOLOGY OF GROENLANDIA DENSA (EXPERIMENTELLE UNTERSUCHUNGEN ZUR AUTOKOLOGIE VON GROENLANDIA DENSA),

Hohenheim Univ., Stuttgart (Germany, F.R.). Inst. fuer Landeskultur und Pflanzenokologie.
A. Kohler, and U. Meyer.

Archiv fuer Hydrobiologie AHYBAY, Vol. 106, No. 4, p 525-540, June 1986. 9 fig, 3 tab, 13 ref.

Descriptors: *Plant growth, *Aquatic plants, *Groenlandia densa, *Photosynthesis, Oxygen, Carbon dioxide, Bicarbonate, Plant morphology, Plant physiology, Light intensity.

In three parts the ecological-physiological reaction of Groenlandia densa was examined by varied conditions in the laboratory and a natural habitat. The experiments showed the following results: (1) In Erms-water, as a natural medium, the highest NPR (16.6 mg O2/g/h/l) was found. A similar result (16.0 mg O2/g/h/l) was obtained by using aqua dest. with a Gaudet-nutrient-solution, which proved to be equally suitable. In tap water, just minor NPR could be determined even by improv-

ing other conditions; (2) An increase in luminous intensity (0-30,000 lx) brought about an increase of NPR, with the point of compensation at 850 lx. The maximum NPR was at 22 C. The dependence of NPR on the supply of CO2/HCO3 can be shown with the maximum NPR reached at pH7; and (3) Current had a stimulating effect on the growth of light exposed shoots. Current with shade exposed shoots brought about minor length and inhibition of branches and roots. (Lantz-PTT)
W87-02336

STRUCTURE AND DYNAMICS OF THE FRENCH UPPER RHONE ECOSYSTEMS: 27. POPULATIONS DYNAMICS OF GAMMARIDS (STRUCTURE ET FONCTIONNEMENT DES ECOSYSTEMES DU HAUT-RHONE FRANCAIS: 27. DYNAMIQUE DES POPULATIONS DE GAMMARES),
Lyon-1 Univ., Villeurbanne (France). Dept. de Biologie Animale et Ecologie.
J. Dessaix.
Archiv fuer Hydrobiologie AHYBAY, Vol. 106, No. 4, p 541-558, June 1986. 7 fig, 19 ref.

Descriptors: *Gammarids, *Population dynamics, *Rhone River, *Canal de Jonage, *Canal de Miribel, Seasonal variation, Ecosystems, Graphical analysis, Genissiat Reservoir, France.

Populations of Gammarids were sampled in the Rhone River above Lyon, using artificial substrates, during four years (from April 1975 to May 1979). From January 1978 to May 1979, three sampling places: the Rhone River, the 'canal de Jonage' and the 'canal de Miribel', were compared. The population numbers are influenced by some factors of the ecosystem, mainly the discharge. The life history graph shows the presence of every size throughout the year, but reproduction is high from March to June and very low from November to January. The growth is largely influenced by the season. The emptying and cleaning of the Genissiat reservoir, in June 1978 strongly disturbed the populations of the main stream and of the 'canal de Jonage'. The populations living in the 'canal de Miribel' were not damaged. This was probably due to the low discharge in the canal at that period. (Author's abstract)
W87-02337

ECOLOGY OF IPHIGENIA TRUNCATA IN LAGOS LAGOON,
Lagos Univ. (Nigeria). Dept. of Biological Sciences.
J. A. Oyenekan, and J. E. Bolufawi.
Archiv fuer Hydrobiologie AHYBAY, Vol. 106, No. 4, p 559-566, June 1986. 4 fig, 11 ref.

Descriptors: *Iphigenia truncata, *Lagos Lagoon, *Ecology, Bivalves, Saline water, Temperature, Dissolved oxygen, Ecological distribution, Nigeria.

The distribution, habits and ecology of Iphigenia truncata in Lagos lagoon are described. The bivalve's response to varying salinities, temperature and dissolved oxygen content were studied. I. truncata occurs in large densities in the shallow muddy sand deposits of the Southeast of the lagoon where water currents are low. I. truncata is stenohaline, abundant in salinities between 0.5 and 23 parts per thousand, but absent in higher salinity areas. It rarely burrows below 3.5 cm below the surface. When completely burrowed, the siphons extend about 13 mm above the sediment surface. The quiescent temperature is 42 C. (Author's abstract)
W87-02338

MORPHOLOGICAL ADAPTATIONS FOR ALLOCHTHONOUS FEEDING IN RASBORA DANICONIUS (HAMILTON),
Kerala Univ., Trivandrum (India). Dept. of Aquatic Biology and Fisheries.
K. P. Kumar, and P. A. John.
Archiv fuer Hydrobiologie AHYBAY, Vol. 106, No. 4, p 567-573, June 1986. 8 fig, 1 tab, 16 ref.

Descriptors: *Morphology, *Allochthonous feeding, *Rasbora daniconius, *Puntius amphibius, Diets, Fish physiology, Fish diets.

The terminal position of the mouth of Rasbora daniconius is suitable to its surface feeding and the ventral position of the mouth of Puntius amphibius is suitable to its bottom feeding nature. The gill rakers in P. amphibius are more numerous and closely spaced when compared to R. daniconius. This is so because R. daniconius does not require a sieving mechanism to feed on its allochthonous diet. The distal ends of the pharyngeal teeth of R. daniconius would prevent the more volatile terrestrial insects present in its allochthonous diet from escaping from the oral grip whereas P. amphibius does not require such an adaptation. Both have a well defined masticatory apparatus and so the stomach is replaced by an intestinal bulb in both. The allochthonous food being predominantly carnivorous, R. daniconius has a lower RLG value compared to P. amphibius which has an omnivorous and predominantly herbivorous diet. (Lantz-PTT)
W87-02339

ENZYMATIC DECOMPOSITION OF ORGANIC MATTER BY BACTERIA IN AN EUTROPHIC LAKE,
Warsaw Univ. (Poland). Dept. of Environmental Microbiology.
For primary bibliographic entry see Field 5C.
W87-02340

UREA METABOLISM AND ITS SIGNIFICANCE IN THE NITROGEN CYCLE IN THE EUPHOTIC LAYER OF LAKE BIWA: II. HALF-SATURATION CONSTANT FOR NITROGEN ASSIMILATION BY FRACTIONATED PHYTOPLANKTON IN DIFFERENT TROPHIC AREAS,
Osaka Kyoiku Univ. (Japan). Lab. of Environmental Science and Education.
O. Mitamura.
Archiv fuer Hydrobiologie AHYBAY, Vol. 107, No. 2, p 167-182, August 1986. 2 fig, 4 tab, 30 ref.

Descriptors: *Ureas, *Metabolism, *Euphotic layer, *Lake Biwa, *Nitrogen cycle, Phytoplankton, Limnology, Ammonia, Chemical analysis, Population dynamics, Trophic zone, Japan.

To obtain some information on the influence of natural phytoplankton cell size and the trophic state of the water region upon the response of urea, ammonia and nitrate nitrogen assimilation and urea decomposition, sample waters taken from surface layers at four stations showing a different trophic character in Lake Biwa were separated into three fractions. The assimilation of urea and ammonia nitrogen by phytoplankton populations in the smaller fraction (< 25 micron) exceeded those in the middle (25-70 micron) and larger fractions (>70 micron). The results of fractionated experiments of the urea decomposition showed a similar trend to those of the urea nitrogen assimilation. The half-saturation constants (K sub s) for the nitrogen assimilation of three compounds were lower, or comparable to, the ambient nitrogen concentrations. The K sub s value approximately increased with the phytoplankton cell size and the trophic state of the water region. This suggests that the phytoplankton population in the oligotrophic area has adapted to the lower nutrient concentrations, and has the capacity for a higher assimilation than in the eutrophic area. The smaller phytoplankton would have a competitive advantage over larger phytoplankton in the assimilation of nitrogen. (Author's abstract)
W87-02341

THERMAL STRATIFICATION IN A TROPICAL AFRICAN RESERVOIR (THE GUMA DAM, SIERRA LEONE),
Fourah Bay Coll., Freetown (Sierra Leone). Dept. of Botany.
O. S. M. Mtada.
Archiv fuer Hydrobiologie AHYBAY, Vol. 107, No. 2, p 183-196, August 1986. 7 fig, 11 ref.

Descriptors: *Thermal stratification, *Limnology, *Guma Dam, *Sierra Leone, *Reservoirs, Tropical regions, Temperature, Epilimnion, Withdrawal, Wind abstraction, Inflows.

A fifteen-month study of the Guma Dam showed that it was thermally stratified for eleven months. Surface warming raised the temperature of this layer from 22-30 C while prolonged surface stirring by winds produced a 10 m deep epilimnion. Once the reservoir was stratified, its thermal stability was maintained by the entry of cooler waters from the inflows which entered the standing waters as profile-bound density currents that always kept the temperatures of the bottom layer below those ever recorded at the surface. Hence there was not significant change in the temperature of the bottom layer. Thermal stratification was also promoted by bottom water withdrawal, wind abstraction by surrounding forests and the location of the Dam in a depression. The breakdown of thermal stratification was caused by prolonged surface cooling and increased entry of flood waters from the inflows which caused overflowing at the Dam's spillway during the rainy season. Guma Dam mixed once per year and is therefore warm monomictic. (Author's abstract)
W87-02342

MICROBIAL INVESTIGATIONS IN RIVERS: V. TAXONOMICAL ANALYSIS OF BACTERIA POPULATIONS FROM THE RIVERS ELBE AND TRAVE AT DIFFERENT SEASONS (MIKROBIOLOGISCHE UNTERSUCHUNGEN IN FLUSSEN: V. TAXONOMISCHE ANALYSE VON BAKTERIENPOPULATIONEN AUS ELBE AND TRAVE ZU VERSCHIEDENEN JAHRESZEITEN),
Kiel Univ. (Germany, F.R.). Inst. fuer Polarokologie.
M. Bolter, M. Meyer, and G. Rheinheimer.
Archiv fuer Hydrobiologie AHYBAY, Vol. 107, No. 2, p 203-214, August 1986. 2 fig, 5 tab, 17 ref.

Descriptors: *Taxonomy, *Bacteria, *Elbe River, *Trave River, *Germany, Population dynamics, Seasonal variation, Statistical analysis, Hydrologic properties, Chemical analysis, Data interpretation.

Analyses by numerical taxonomy of saprophytic bacteria of two diverse rivers (Elbe and Trave, Northern Germany) at different seasons showed that the combination of the bacteria population was more influenced by the season than by locality. A comparison of concomitantly monitored hydrological and chemical parameters by non-parametric statistics and cluster analysis underlined this result and revealed in a separation of the summer aspect from the other data. The results are discussed in relation to literature data. The importance of multivariate data analysis in such studies is pointed out. (Lantz-PTT)
W87-02343

ANALYSIS OF THE EPHEMEROPTERA-EMERGENCE OF THE BREITENBACH NEAR SCHLITZ/HESSE (F.R.G.), (ANALYSE DER EPHERMEROPTERA-JAHRESEMERGENZ DES BREITENBACHES BEI SCHLITZ/HESSEN (BUNDESREPUBLIK DEUTSCHLAND)),
U. Jacob.
Archiv fuer Hydrobiologie AHYBAY, Vol. 107, No. 2, p 215-248, August 1986. 8 fig, 18 tab, 20 ref.

Descriptors: *Insects, *Breitenbach, *Germany, *Population dynamics, Mayflies, Aquatic insects, Taxonomy, Biomass, Seasonal variation, Floods, Temporal distribution, Statistical analysis.

Ephemeroptera emerging from the Breitenbach, a subterranean stream in Hesse, West Germany in 1984, were analyzed and compared with mayfly emergence from the preceding year. Five (1984) or seven (1983) greenhouses, each 6 m long, were used as emergence traps along a 2,000 m stretch of stream. In 1984, 17,083 mayfly specimens (13 species) were taken in the traps. The 13, 586 specimens collected in 1983 included two additional species. The revised Ephemeroptera list from the Breitenbach includes 16 species. However, only six of these (Baetis rhodani, Baetis vernus, Ephermella ignita, Ephermella mucronata, Paraleptophlebia submarginata and Centroptilum luteolum) appear to be permanently established in the Breitenbach,

and the last two only occasionally contribute significantly to total biomass. Dominance structure may change from year to year, and in particular, the abundance of B. vernus varies dramatically. According to findings in 1983 and 1984, emergence of established species from the Breitenbach produces a low early summer peak during the first third of June. Thereafter emergence rates are lower, extending, when the weather is unfavorable, into July. Later, there is an extremely high summer peak accounting for most of the annual emergence. In the Breitenbach, however, only B. rhodani, B. vernus and E. ignita contribute to this. Both temporal emergence patterns and monthly diversity show remarkable agreement between 1983 and 1984. Summation of monthly diversity indices clearly demonstrates diversity losses due to exceptional events, such as floods, or egg masses falling dry. Distribution of established Ephemeroptera species along the Breitenbach is either regular (dispersed), or transgredient-proximal (exhibiting a regular cline). This agrees with and documents the considerable homogeneity of the system.To describe both clinal changes in the Ephemeroptera fauna and 'disturbances' (siltation, caused by local human interference) mathematically, H sub i, a density-corrected index of diversity is proposed. Spatial patterns of H sub i for Ephemeroptera in 1983 and 1984 agree well and change gradually along the stream, thereby revealing a clinal trend of H sub i, at least for Ephemeroptera, in the epirhithral of the Breitenbach. (Lantz-PTT)
W87-02344

AEROBIC UPTAKE OF FE(III)-PRECIPITATED PHOSPHORUS BY MICROORGANISMS,
Lund Univ. (Sweden). Limnological Inst.
S. Fleischer.
Archiv fuer Hydrobiologie AHYBAY, Vol. 107, No. 2, p 269-277, August 1986. 5 fig, 22 ref.

Descriptors: *Aerobic bacteria, *Limnology, *Iron, *Phosphorus, Microorganisms, Chemical precipitation, Sediments, Enzymes, Chemical reactions.

Phosphorus co-precipitated with Fe(III) was microbially released in mixed and pure cultures as well as in intact sediment-water systems. The precipitated P was labelled and the original P in microorganisms was left unlabelled in order to trace the P transfer. Microorganisms released P from the precipitate under aerobic conditions while the Fe(III) gel was solubilized and probably underwent peptization. P removed from the precipitate was, to a large extent, kept in the microorganisms as these later released P under anaerobic conditions. The results show that biotic exchange processes are far more important in phosphorus dynamics than previously thought. (Author's abstract)
W87-02346

ORIGIN AND DEFORMATION OF HOLOCENE SHORELINE TERRACES, YELLOWSTONE LAKE, WYOMING,
Montana State Univ., Bozeman. Dept. of Earth Sciences.
G. A. Meyer, and W. W. Locke.
Geology GLGYB, Vol. 14, No. 8, p 699-702, August 1986. 3 fig, 24 ref.

Descriptors: *Shores, *Yellowstone Lake, *Wyoming, *Geological terraces, *Geologic history, Holocene era, Lake formation, Shorelines.

Geodetic surveys within the Yellowstone caldera have documented active uplift that is most likely caused by magmatic processes in the upper crust. Along the northeast shore of Yellowstone Lake, maximum relative uplift rates are 10 mm/yr for the period 1923-1975. However, information on deformation prior to historic instrumental records has been lacking. In this study, closely spaced data on elevations of postglacial shoreline terraces around the north end of Yellowstone Lake reveal complex tilting. Though most Holocene deformation is probably magma related, the pattern of shoreline tilting deviates significantly from the historic pattern of roughly symmetric inflation of the caldera. Along the northeast shore, where tilt directions of historic and shoreline deformation are similar, differential uplift of a > 2500-yr-old terrace is roughly 10 m; this gives a maximum uplift rate of 4 mm/yr. These unique Holocene terraces may exist due to episodic deformation because vertical movements affecting the lake outlet directly control lake level. (Author's abstract)
W87-02370

ROLE OF ORGANIC ACIDS IN THE ACID-BASE STATUS OF SURFACE WATERS AT BICKFORD WATERSHED, MASSACHUSETTS,
Massachusetts Inst. of Tech., Cambridge. Ralph M. Parsons Lab. for Water Resources and Hydrodynamics.
K. N. Eshleman, and H. F. Hemond.
Water Resources Research WRERAQ, Vol. 21, No. 10, p 1503-1510, October 1985. 5 fig, 3 tab, 44 ref.

Descriptors: *Organic acids, *Acid rain, *Surface waters, *Bickford Watershed, *Massachusetts, *Chemical reactions, Alkalinity, Hydrogen ion concentration, Anions, Cations, Dissolved organic carbon, Watersheds, Chemical analysis, Acid.

An experimental field study of the alkalinity and major ion budgets of Bickford watershed in central Massachusetts indicates that organic acid production by the ecosystem contributes measurably to surface water acidification. Applying the concepts of alkalinity, electroneutrality of solutions, and mass balance, organic acids were found to comprise 20% of all strong acid sources on one subcatchment annually, a value half as large as the measured bulk mineral acid deposition. Inorganic cation to anion ratios in Provencial brook varied between 1.0 in winter and 1.6 during summer, suggesting the presence of up to 100 microequivalents/L of unmeasured charge from organic anions during the growing season. Base titrations and ultraviolet photooxidation experiments confirmed the existence of low pK (3.5-5.0) acidic functional groups. A positive linear relationship between dissolved organic carbon (DOC) and anion deficit for a group of surface and groundwater samples indicates the DOC contains about 7.5 microequivalents carboxylic groups/gm C. Biological factors related to both upland and wetland carbon metabolism apparently control this natural acidification phenomenon, which has not been documented on other watersheds in the northeastern United States for which annual alkalinity budgets have been determined. (Author's abstract)
W87-02380

KESTERSON STORY,
Bureau of Reclamation, Sacramento, CA. Mid-Pacific Regional Office.
For primary bibliographic entry see Field 5C.
W87-02480

INVESTIGATING ERROR IN CALCULATION OF AREAL CHLOROPHYLL A CONCENTRATION IN TWIN LAKES, COLORADO,
Bureau of Reclamation, Denver, CO. Engineering and Research Center.
S. G. Campbell.
Available from the National Technical Information Service, Springfield, VA. 22161, as PB86 229606, A02 in paper copy, A01 in microfiche. Report REC-ERC-85-9, December 1985. 11 p, 8 fig, 2 tab, 9 ref.

Descriptors: *Chlorophyll A, *Twin Lakes, *Colorado, *Error analysis, *Limnology, Chemical analysis, Sampling, Water analysis, Water depth, Algae, Thermocline.

Analysis of chlorophyll a data collected at Twin Lakes, Colorado, from 1977 to 1981 indicated a possible error in areal chlorophyll concentrations extrapolated from six-point samples collected along a 0-15 m depth profile. Field experiments to identify the sources of error in areal chlorophyll a concentration were conducted during the ice-free seasons of 1982 and 1983. Two different methods of sample collection were used. The first was a six-point depth profile. The second, an integrated (composite) 0-15 m sample collected with a flexible PVC hose. Two probable sources of error were identified. First, a standard sampling depth (9 m) sometimes coincided with the bottom of the thermocline during summer stratification. Algae tend to settle at the density interface along the bottom of the thermocline, which can result in a concentrated layer of algae of variable thickness. Second, some algal layers occurred at depths not routinely sampled by the 6-point depth profile method. (Author's abstract)
W87-02547

BIGHORN LAKE - 1982 SEDIMENTATION SURVEY,
Bureau of Reclamation, Denver, CO. Engineering and Research Center.
For primary bibliographic entry see Field 2J.
W87-02548

PRIMARY PRODUCTIVITY (C-14) AT TWIN LAKES COLORADO: 1973-81 STUDY RESULTS,
Bureau of Reclamation, Denver, CO. Engineering and Research Center.
J. F. LaBounty, S. G. Campbell, and J. J. Sartoris.
Available from the National Technical Information Service, Springfield, VA. 22161 as PB86 233285, A03 in paper copy, A01 in microfiche. Report No. REC-ERC-85-8, December 1985. 35 p, 22 fig, 9 tab, 19 ref, append.

Descriptors: *Primary productivity, *Twin Lakes, *Colorado, *Carbon radioisotopes, Limnology, Lake morphology, Productivity, Powerplants, Ecological effects, Nutrients, Carbon, Reservoirs.

Primary productivity and its limiting factors were studied in Twin Lakes, Colorado, during 1973-81, to characterize the lakes limnologically before operations began at the pumped-storage powerplant then under construction on the lower lake. The lakes are a pair of connected, dimictic, montane, drainage lakes of glacial origin, classified as oligotrophic. The upper lake receives spring runoff directly, and its volume strongly influences the limnology of both lakes. Both lakes also receive unknown, but limited, amounts of local runoff which - like spring runoff - contains nutrients that support primary production in Twin Lakes. Based on 82 observations, the range of primary production rates in the upper lake is 1 to 104 mg C/sq m/d. That in the lower lake, based on 86 observations, is 5 to 312 mg C/sq m/d. The mean daily production rate for the same number of observations from 1973-81 was 33.6 and 63.9 mg C/sq m/d. The average annual productivity over the 9 years of study was 11.3 and 25.8 g C/sq m/annum for the upper and lower lakes, respectively. The maximum rates of primary production were observed at spring and fall circulation periods. The lowest production rates were observed during winter, under the ice, especially in those years when snow and ice cover were thickest. Runoff transports nutrients that are at other times limited. The years with greatest runoff were observed to have the highest rates of primary production in Twin Lakes. However, these higher rates were observed only in the lower lake, because the increased turbidity and flushing caused by heavy spring runoff severely limits primary production in the upper lake. The data in this report, with other limnological and fishery data from Twin Lakes, will be used with postconstruction data now being collected to evaluate the effects of pumped-storage powerplant operation on the ecology of Twin Lakes. (Author's abstract)
W87-02550

PREDICTING AND EVALUATING THE EFFECTS OF ACIDIC PRECIPITATION ON WATER CHEMISTRY AND ENDEMIC FISH POPULATIONS IN THE NORTHEASTERN UNITED STATES,
Columbia National Fisheries Research Lab., MO.
For primary bibliographic entry see Field 5C.
W87-02552

ROLE AND IMPORTANCE OF ECOSYSTEMS IN THE BIOSPHERE,
University of Agriculture, Godollo (Hungary). Dept. of Botany and Plant Physiology.
For primary bibliographic entry see Field 2K.
W87-02555

WATER POLLUTION,
For primary bibliographic entry see Field 5C.
W87-02556

2I. Water In Plants

NITROGEN FIXATION BY NON-LEGUMES IN TROPICAL AGRICULTURE WITH SPECIAL REFERENCE TO WETLAND RICE,
International Rice Research Inst., Los Banos, Laguna (Philippines). Soil Microbiology Dept.
I. Watanabe.
Plant and Soil PLSOA2, Vol. 90, No. 1-3, p 343-357, 1986. 1 tab, 58 ref.

Descriptors: *Rice, *Wetlands, *Nitrogen fixation, *Tropics, *Cyanophyta, *Azolla, *Anabaena, *Symbiosis, Crop yield, Plant physiology, Bacteria, Rhizocoenosis, Soil algae, Soil bacteria, Flooding.

Wet or flooded conditions favor biological nitrogen fixation by providing photic-oxic floodwater and surface soil for phototrophic, free-living or symbiotic blue-green algae (BGA) and aphotic-anoxic soil for anaerobic or microaerobic, heterotrophic bacteria. The Azolla-Anabaena symbiosis can accumulate as much as 200 kg N/ha in biomass. In tropical flooded fields, biomass production from a single Azolla crop is about 15 tones fresh weight per hecatare or 35 kg N/ha. Although there are many reports of the positive effect of BGA inoculation on rice yield, the mechanisms of yield increase are not know. Efficient ways to increase N2 fixation by field-grown BGA are now well exploited. Bacteria associated with rice roots and the basal portion of the shoot also fix N2 in the system known as the rhizocoenosis. N2-fixation in the rhizocoenosis of wetland rice is lower than with Azolla or BGA. Screening rice varieties that greatly stimulate N2 fixation may be the most efficient way of manipulating the rhizocoenosis. (Author's abstract)
W87-01772

LABORATORY ACETYLENE REDUCTION ASSAY FOR RELATIVE MEASUREMENT OF N2-FIXING ACTIVITIES ASSOCIATED WITH FIELD-GROWN WETLAND RICE PLANTS,
International Rice Research Inst., Los Banos, Laguna (Philippines). Soil Microbiology Dept.
W. L. Barraquio, M. L. G. Daroy, A. C. Tirol, J. K. Ladha, and I. Watanabe.
Plant and Soil PLSOA2, Vol. 90, No. 1-3, p 359-372, 1986. 5 fig, 6 tab, 27 ref.

Descriptors: *Soil bacteria, *Nitrogen fixation, *Acetylene reduction, *Rice, *Assay, Varietal differences, Bacterial physiology.

A short-term laboratory acetylene reduction assay using cut plant-soil samples incubated in the dark was developed for measuring relative N2-fixing activities associated with field-grown rice plants. The assay sample consists of rhizosphere soil, root, and cut stem and leaf sheath. The cut plant-soil assay is relatively simple, rapid, and convenient; it reduces, if not eliminates, the problems encountered in whole-plant (field, pot, and water culture) and excised roots assays. Varietal differences in N2-fixing activity were detected with the new technique. Dynamics of the bacterial population associated with cut plant-soil incubated under C2H2 also is described. (Author's abstract)
W87-01773

EFFECT OF INCORPORATION OF CROP RESIDUES ON DEVELOPMENT OF DIAZOTROPHS AND PATTERNS OF ACETYLENE-REDUCING ACTIVITY IN NILE VALLEY SOILS,
Cairo Univ., Giza (Egypt). Faculty of Agriculture.
For primary bibliographic entry see Field 2G.
W87-01774

GROWTH OF VIGNA UNGUICULATA L. VAR. GWL K3B IN SUB-OPTIMAL MOISTURE CONDITIONS AS INFLUENCED BY CERTAIN ANTITRANSPIRANTS,
Jiwaji Univ., Gwalior (India). School of Studies in Botany.
For primary bibliographic entry see Field 3F.
W87-01775

DROUGHT AND SHADE INTERACT TO CAUSE FINE-ROOT MORTALITY IN DOUGLAS-FIR SEEDLINGS,
Oregon State Univ., Corvallis. Dept. of Forest Science.
J. D. Marshall.
Plant and Soil PLSOA2, Vol. 91, No. 1, p 51-60, 1986. 4 fig, 36 ref. NSF Grant DEB 8112455.

Descriptors: *Douglas-fir trees, *Shading, *Watering, *Carbohydrates, *Root mortality, *Water stress, Temperature, Translocation, Drought, Plant physiology, Seedlings, Starch, Sugars, Respiration.

Douglas-fir seedlings were subjected to four combinations of shading and watering to determine whether shading increases drought-induced fine-root (< or = 2 mm in diameter) mortality and, if so, whether this effect is due to reduced levels of carbohydrate reserves or increased susceptibility to desiccation. Two correlated measures of root mortality (counting root tips and weighing roots) showed that significantly more fine roots died only when seedlings were both shaded and unwatered. Concentrations of suberin were unaffected by any combination of shading and watering, but carbohydrate reserves were nearly exhausted in the shaded and unwatered treatment, which also had the highest root mortality. Water stress may have increased root mortality indirectly by increasing root temperature and maintenance respiration and by inhibiting photosynthate transport to the root system, but the massive die-off in response to drought was apparent only when starch and sugar reserves were nearly depleted. The fine root's ability to respire, which depends on the status of its starch and sugar reserves, seems to be the primary physiological control of fine-root mortality. (Author's abstract)
W87-01776

RESPONSE OF SORGHUM AND SUNFLOWER TO SHORT-TERM WATERLOGGING: IV. WATER AND NUTRIENT UPTAKE EFFECTS,
University of New England, Armidale (Australia). Dept. of Agronomy and Soil Science.
P. W. Orchard, R. S. Jessop, and H. B. So.
Plant and Soil PLSOA2, Vol. 91, No. 1, p 87-100, 1986. 6 fig, 6 tab, 20 ref.

Descriptors: *Sorghum, *Sunflowers, *Waterlogging, *Plant water potential, *Plant growth, Plant physiology, Transpiration, Development, Anthesis, Phosphorus, Nutrients, Potassium, Seeds, Reproduction.

The effect of waterlogging on water use and nutrient uptake in sunflower and sorghum was investigated in relation to stage of development of the crops and the timing and duration of waterlogging. Waterlogging at the vegetative and floral initiation stages of plant growth induced a reduction in water use of sunflower, with corresponding declines in leaf expansion and leaf water potential; in sorghum, the transpiration rates were much lower than for sunflower and were relatively unaffected by waterlogging. Water logging at anthesis, however, caused and immediate reduction in water use in sunflower with a similar, but delayed effect in sorghum. Analysis of mature plants indicated that waterlogging at any growth stage reduced both total and seed P in sunflower; similar effects were recorded with sorghum, except that waterlogging at anthesis did not reduce nutrient uptake. Waterlogging effects on plant K levels varied. (Author's abstract)
W87-01777

ENHANCEMENT OF WATER STATUS BY CALCIUM PRETREATMENT IN GROUNDNUT AND COWPEA PLANTS SUBJECTED TO MOISTURE STRESS,
University of Agricultural Sciences, Bangalore (India). Dept. of Crop Physiology.
M. Chari, K. Gupta, T. G. Prasad, K. S. Krishna Sastry, and M. Udaya Kumar.
Plant and Soil PLSOA2, Vol. 91, No. 1, p 109-114, 1986. 1 fig, 3 tab, 12 ref.

Descriptors: *Calcium, *Groundnut, *Cowpea, *Moisture stress, Membranes, Plant physiology, Plant water potenial.

The effect of Ca at 0, 0.5 x, 1.0 x, and 2.0 x the recommended amount in Hoagland's medium on the water relations and tolerance to moisture deficits was tested in groundnut and cowpea grown in sand. In both species, enrichment of tissue with calcium resulted in maintenance of a higher water status under stress associated with low proline accumulation. The extent of the membrane damage (as reflected by the absorbance at 237 nanometer) was less in leaves of plants fed with higher levels of Ca(2+) when subjected to the simulated stress. The rate of water loss from the leaves of Ca(2+)-enriched plants also was lower. The possible role of Ca(2+) in inducing membrane stability and maintenance of higher water status is discussed. (Rochester-PTT)
W87-01778

EFFECT OF STRAW EXTRACT ON WATER ABSORPTION AND GERMINATION OF WHEAT (TRITICUM AESTIVUM L. VARIETY RR-21) SEEDS,
Govind Ballabh Pant Univ. of Agriculture and Technology, Pantnagar (India). Dept. of Soil Science.
For primary bibliographic entry see Field 3F.
W87-01779

ROOT GROWTH OF SOYBEAN (GLYCINE MAX L. MERR.) AND COWPEA (VIGNA UNGUICULATA WALP.) ON A HYDROMORPHIC TOPOSEQUENCE IN WESTERN NIGERIA,
International Inst. of Tropical Agriculture, Ibadan (Nigeria).
N. R. Hulugalle, and R. Lal.
Plant and Soil PLSOA2, Vol. 91, No. 2, p 195-208, 1986. 7 fig, 4 tab, 21 ref.

Descriptors: *Soybeans, *Cowpea, *Root growth, *Soil water, *Water table, Satuaration, Evapotranspiration, Water use efficiency, Toposequence, Nigeria, Capillary zone, Plant physiology.

The effects of variations in edaphic and hydrologic factors over a short distance on the root growth of soybean cv. Hernon 237 and cowpea cv. IT 82 E-60 were studied in a hydromorphic toposequence. During the growing seasons the water table (WT) fluctuated from 0.43 to 0.94 m (high, 0.60 to 1.12 m (medium), and 0.72 to 1.51 m (low), respectively, in 1983 and from 0.47 to 0.84 m (high), 0.63 to 1.13 m (medium), and 0.83 to 1.20 m (low), in 1984. Poor soil aeration did not limit growth, even for high WT. Root penetration into the deeper soil was prevented at the low- and medium-water table sites by the presence of a naturally-occurring compacted gravel layer at the 0.30-0.40 m depth. The absence of this layer at the high water table site resulted in root growth and proliferation of soybean roots even within the capillary fringe zone immediately above the water table. Cowpea roots, however, were not observed in this saturated soil zone. Cowpea roots penetrated deeper in high than in medium and low WT. Evapotranspiration (Et) and Et/potential water use, ie, relative water use values of both crops were significantly greater at the high than at the medium or low water table. (Author's abstract)
W87-01780

ROLE OF ETHYLENE DURING FLOODING OF PHASEOLUS VULGARIS,
Utrecht Rijksuniversiteit (Netherlands). Botanical Lab.

H. Wadman-van Schravendijk, and O. M. van Andel.
Physiologia Plantarum PHPLAI, Vol. 66, No. 2, p 257-264, February 1986. 5 fig, 34 ref.

Descriptors: *Ethylene, *Flooding, *Phaseolus vulgaris, *Ethrel, *Abscisic acid, *Wilting, *Diffusion resistance, Stomata, Plant physiology.

Wilting symptoms of P vulgaris cv bruine Noord-Hollandse were observed after a few hours of flooding. They were well correlated with an accumulation of ethylene. The ethylene level in the leaves started to increase after 2 hr of flooding and reached a 3- to 4-fold rise after 4-6 hr. Over the next two days it gradually returned to control values. On the day when plants were flooded, a positive correlation was found between the ethylene concentration and the degree of wilting. During this day the time course of abscisic acid (ABA) level, diffusion resistance and water potential was measured. Spraying 0.12% Ethrel (2-chloroethylphosphonic acid, 480 g/l) on the leaves of control plants had no influence on diffusion resistance. Spraying plants with ABA resulted in a significant, dose-dependent increase in diffusion resistance. When Ethrel was added to the ABA-containing solutions only 62% of this increase was observed. Ethrel (pre-) treatment of plants that were flooded had a similar effect; the increase in diffusion resistance was only 70% of that observed in untreated flooded plants. Ethylene may interfere with the regulation of stomatal aperture by ABA. (Author's abstract)
W87-01782

ETHYLENE AND ETHANE RELEASE DURING TOBACCO PROTOPLAST ISOLATION AND PROTOPLAST SURVIVAL POTENTIAL IN VITRO,
University Coll., Cork (Ireland). Dept. of Plant Science.
A. C. Cassells, and L. Tamma.
Physiologia Plantarum PHPLAI, Vol. 66, No. 2, p 303-308, February 1986. 8 fig, 1 tab, 16 ref.

Descriptors: *Ethylene, *Ethane, *Tobacco, *Water stress, *Waterlogging, *Protoplast isolation, *Protoplast survival, *In vitro technique, *Stress, Plant physiology, Plant pathology.

Studies on stress ethylene and ethane during protoplast isolation from water-stressed and waterlogged donor plants, Nicotiana tabacum L. xanthinc, showed a correlation between ethane, but not ethylene, release and survival of protoplasts in vitro. Ethane release showed a high negative correlation with protoplast survival potential from donor plants subjected to both stresses. Ethylene showed a high negative correlation with protoplast survival potential in tissues from water-stressed but not from long-term waterlogged plants. The absence of a correlation in the latter may be related to decreased ability to produce ethylene in hyperstressed plants. Use of stress ethane release as a parameter of the physiological status of the plant is discussed. (Author's abstract)
W87-01783

EFFECTS OF N NUTRITION ON THE WATER RELATIONS AND GAS EXCHANGE CHARACTERISTICS OF WHEAT (TRITICUM AESTIVUM L.),
Agricultural Research Service, Fort Collins, CO.
J. A. Morgan.
Plant Physiology PLPHAY, Vol. 80, No. 1, p 52-58, January 1986. 4 fig, 3 tab, 30 ref.

Descriptors: *Wheat, *Nutrients, *Soil-water-plant relationships, *Carbon dioxide, *Nitrogen, *Photosynthesis, *Gas exchange, Stomata, Growth chambers, Plant physiology, Leaf conductance, Tissue elasticity, Biomass, Fertilizers, Water potentials.

Leaf photosynthetic and stomatal responses were characterized with the plant grown under two N-nutritional regimes. High- and low-N regimes were imposed on growth-chamber-grown plants by fertilizing with nutrient solutions containing 12 or 1 millimolar N. Gas-exchange measurements indicated not only greater photosynthetic capacity of high-N plants under well-watered conditions, but a greater sensitivity of CO2 exchange rate and leaf conductance to CO2 and leaf water potential compared to low-N plants. Increased sensitivity of high-N plants was associated with greater tissue elasticity, lower values of leaf osmotic pressure and greater aboveground biomass. These N-nutritional-related changes resulted in greater desiccation (lowered relative water content) of high-N plants as leaf water potential fell, and were implicated as being important in causing greater sensitivity of high-N leaf gas exchange to reductions in water potential. Water use efficiency of leaves, calculated as CO2 exchange rate/transpiration, increased from 9.1 to 13 millimoles per mole and and 7.9 to 9.1 millimoles per mole for high- and low-N plants, respectively, as water became limiting. Stomatal oscillations were observed commonly in the low-N treatment at low leaf water potentials and ambient CO2 concentrations, but disappeared as CO2 was lowered and stomata opened. (Author's abstract)
W87-01830

OSMOTIC RESPONSE OF SUGAR BEET SOURCE LEAVES AT CO2 COMPENSATION POINT,
Dayton Univ., OH. Dept. of Biology.
T.C. Fox, and D. R. Geiger.
Plant Physiology PLPHAY, Vol. 80, No. 1, p 239-241, January 1986. 4 fig, 21 ref. NSF Grants PCM-80088720 and DMB-8303957.

Descriptors: *Sugar beets, *Carbohydrate metabolism, *Source leaves, *Carbon dioxide, *Compensation point, *Water potentials, *Osmosis, Plant physiology, Photosynthesis, Sucrose, Glucose, Fructose, Starch, Radioactive tracers.

As sugar beet source leaves lowered the CO2 concentration io compensation point in a closed atmosphere, leaf thickness and relative water content decreased. Leaf water potential declined rapidly from -0.5 to -1.4 megapascals. At 340 microliters CO2 per liter, water potential and sucrose, glucose, and fructose contents were steady in photosynthesizing source leaves. Within 90 min after leaves were exposed to a CO2 concentration at the compensation point, leaf sucrose content declined to 60% of the pretreatment level, rapidly in the first 30 min and then more slowly. During the subsequent 200 min, sucrose content increased to 189% of the pretreatment level. Glucose and fructose remained unchanged during the treatment. Degradation of starch was sufficient to account for the additional sucrose that accumulated. Labeled carbon lost from starch appeared in sucrose and several other compounds that likely contributed to the recovery in leaf water content. (Author's abstract)
W87-01831

WATER STRESS ENHANCES EXPRESSION OF AN ALPHA-AMYLASE GENE IN BARLEY LEAVES,
Commonwealth Scientific and Industrial Research Organization, Campbell (Australia).
J. V. Jacobsen, A. D. Hanson, and P. C. Chandler.
Plant Physiology PLPHAY, Vol. 80, No. 2, p 350-359, February 1986. 9 fig, 33 ref.

Descriptors: *Barley, *Water stress, *Metabolism, *Analyses, Plant water potential, Protein synthesis, Plant growth, Enzymes.

The amylases of barley leaves are characterized, and a promotive effect of water stress on the activity of alpha-amylase is described. The activity increase is due to an enhanced rate of synthesis of a single alpha-amylase isozyme and that is accompanied by an increase in the level of the corresponding mRNA. The amylases of the second leaves of barley seedlings were resolved into eight isozymes by isoelectric focusing, seven of which were beta-amylase and the other, alpha-amylase. The alpha-amylase had the same isoelectric point as one of the gibberellin-induced alpha-amylase isozymes in the aleurone layer. In unwatered seedlings, leaf alpha-amylase increased as leaf water potential decreased and abscisic acid increased. Water stress had no effect on beta-amylase. Alpha-amylase occurred uniformly along the length of the leaf, but beta-amylase was concentrated in the basal half of the leaf. Cell fractionation studies indicated that none of the leaf alpha-amylase occurred inside chloroplasts. Leaf radiolabeling experiments followed by extraction of alpha-amylase activity, involved a synthesis of the enzyme. However, water stress caused no major change in total protein synthesis. Hybridization of a radiolabeled alpha-amylase-related cDNA clone to size fractionated RNA showed that water-stressed leaves contained much more alpha-amylase mRNA than unstressed plants. Regulation of gene expression may be a component in water-stress induced metabolic changes. (Peters-PTT)
W87-01835

COMPARISON OF THE SUBMERGENCE RESPONSE OF DEEPWATER AND NON-DEEPWATER RICE,
MSU/DOE Plant Research Lab., East Lansing, MI.
For primary bibliographic entry see Field 3F.
W87-01836

ENHANCEMENT OF NITRATE UPTAKE AND GROWTH OF BARLEY SEEDLINGS BY CALCIUM UNDER SALINE CONDITIONS,
California Univ., Davis. Plant Growth Lab.
For primary bibliographic entry see Field 3C.
W87-01837

INCREASED ABSCISIC ACID BIOSYNTHESIS DURING PLANT DEHYDRATION REQUIRES TRANSCRIPTION,
Texas A and M Univ., College Station. Dept. of Biochemistry and Biophysics.
F. Guerrero, and J. E. Mullet.
Plant Physiology PLPHAY, Vol. 80, No. 2, p 588-591, February 1986. 2 fig, 1 tab, 13 ref.

Descriptors: *Dehydration, *Abscisic acid, *Biosynthesis, *Water stress, Pea plants, Turgor, Transcription, Actinomycin D, Cordycepin, Biochemical tests, Plant growth.

Excised pea plants were rapidly dehydrated to turgor pressures of 1.5 to 2.0 bars. After a 30 minute lag, abscisic acid (ABA) levels increased approximately 100-fold in the dehydraged plants. Pretreatment of plants with the transcription inhibitors actinomycin D or cordycepin, or with an inhibitor of cytoplasmic protein synthesis prior to plant dehydration, inhibited the synthesis of ABA. Because transcription is required for ABA induction in dehydrated plants, a change in nuclear gene expression is required to produce elevated levels of ABA during plant water stress. (Peters-PTT)
W87-01838

MEMBRANES OF SLOWLY DROUGHT-STRESSED WHEAT SEEDLINGS: A FREEZE-FRACTURE STUDY,
Newcastle upon Tyne Univ. (England). Dept. of Agricultural Biology.
R. S. Pearce.
Planta PLANAB, Vol. 166, No. 1, p 1-14, September 1985. 20 fig, 3 tab, 24 ref. National Science and Engineering Research Council Grant No. A0507.

Descriptors: *Drought, *Wheat, *Water stress, *Plant tissues, Membranes, Leaves, Dehydration, Plant growth.

Seedlings of spring wheat (Triticum aestivum cv. Neepawa) were progressively dehydrated by withholding water after sowing. Observations of the leaf sheath base were made when leaf extension stopped and for up to 19 days later. Damage was assessed by rewatering the pots and measuring regrowth. Intramembranous particles (IMP) were evenly scattered in the plasma membrane in those plants which regrew immediately after rewatering. In the plants which regrew after a delay, or which did not regrow on rewatering, there were patches without IMP in plasma membrane, nuclear envelope, and other membranes. The results support the idea that slow drought induces IMP-free patches in

membranes including the plasma membrane. This in turns induces membrane reorganization, including vesiculation of membranes and coagulation of protoplasm, and becomes expressed by delayed or failed regrowth. As the stress becomes damaging, vesicles and endoplasmic reticulum accumulate next to the plasma membrane. During the early period of damaging stress (6 to 10 days after growth stopped), depressions, invaginations, and rarer 'lesions' occurred in the plasma membrane, sometimes associated with the IMP-free patches. In the same period, many nuclear envelopeS had exceptionally large nuclear pores. (Peters-PTT)
W87-01839

CORRELATION BETWEEN CRASSULACEAN ACID METABOLISM AND WATER UPTAKE IN SENECIO MEDLEY-WOODII,
Zurich Univ. (Switzerland). Inst. of Plant Biology.
B. R. Ruess, and B. M. Eller.
Planta PLANAB, Vol. 166, No. 1, p 57-66, September 1986. 10 fig, 1 tab, 46 ref.

Descriptors: *Transpiration, *Water stress, *Drought, *Metabolism, *Plant physiology, Carbon dioxide, Crassulacean acid metabolism, Gas exchange, Senecio, Osmotic potential, Adaptation, Adsorption.

The combination of a chamber for CO2 gas exchange with a potometric measuring arrangement allowed concomitant investigations into CO2 gas exchange, transpiration and water uptake by the roots of whole plants of Senecio medley-woodii, a species which exhibits Crassulacean acid metabolism. The water-uptake rate showed the same daily pattern as malate concentration and osmotic potential. The accumulation of organic acids resulting from nocturnal CO2 fixation, enhanced the water-uptake rate from dusk to dawn. During the day the water-uptake rates decreased with decreasing organic-acid concentration. With gradually increasing water stress, CO2 dark fixation of S. medly-woodii was increased as long as water could be taken up by the roots. A reestablished water supply after drought caused a similar increase which in both cases ameliorated the water balance for as long as possible. This water-uptake pattern indicates that Crassulacean acid metabolism is not only a water-saving adaptation but also enhances water uptake and is directly correlated with the amelioration of the plant water status. (Author's abstract)
W87-01840

WINTER SURVIVAL AND GROWTH OF CHONDRUS CRISPUS IN ONSHORE CULTURE TANKS,
National Research Council of Canada, Halifax (Nova Scotia). Atlantic Regional Lab.
For primary bibliographic entry see Field 2L.
W87-01845

EFFECTS OF DROUGHT ON PHOTOSYNTHESIS, CHLOROPHYLL FLUORESCENCE, AND PHOTOINHIBITION SUSCEPTIBILITY IN INTACT WILLOW LEAVES,
Umea Univ. (Sweden). Dept. of Plant Physiology.
E. Ogren, and G. Oquist.
Planta PLANAB, Vol. 166, No. 3, p 380-388, November 1985. 8 fig, 2 tab, 45 ref.

Descriptors: *Salix, *Drought, *Chlorophyll, *Photosynthesis, *Stomata, Fluorescence emission, Leaf water potential, Kinetics, Water stress, Acclimation.

Plants from clonal cuttings of Salix sp were subjected to a drying cycle of 10 days in a controlled environment and gas exchange and fluorescence emission were measured in the attached leaves. The light-saturated photosynthetic CO2 uptake became progressively inhibited with decreased leaf water potential, both at high, and especially, at low intracellular pressure. The maximal quantum yield of CO2 uptake was more resistant. The inhibition of light-saturated CO2 uptake and leaf water potentials around -10 bar, measured at a natural ambient CO2 concentration, was equally attributable to stomatal and non-stomatal factors, but the further inhibition below this water-stress level was caused solely by non-stomatal factors. The kinetics of fluorescence emission was changed at severe water stress; the slow secondary oscillations of the induction curve were attenuated, probably indicating perturbations in the carbon reduction cycle. Provided the leaves were properly light-acclimated, drought at high and low light levels produced essentially the same effects on photosynthesis. However, low-light-acclimated leaves became more susceptible to photoinhibitory treatment under severe water stress, as compared with well-watered conditions. (Author's abstract)
W87-01859

PLANT GROWTH IN RIVERS OF THE CENTRAL VOLGA REGION AND ITS RELATION TO ENVIRONMENTAL CONDITIONS,
All-Union Scientific Research Inst. of Game Management and Fur Breeding, Volga (USSR).
V. G. Papchenkov.
Soviet Journal of Ecology SJECAH, Vol. 16, No. 3, p 137-143, May/June 1985. 1 fig, 2 tab, 6 ref. Translated from Ekologiya, Vol. 16, No. 3, p 20-27, May-June 1985.

Descriptors: *Aquatic plants, *Macrophytes, *Rivers, River beds, River channels, Current velocity, Chemical composition, Volga region.

The area of the central Volga was regionalized on the basis of materials from the cartography of higher aquatic vegetation in river channels. Ten regions were distinguished with respect to the intensity of river plant growth, within the limits of which the level of development of river vegetation was described, the dominant macrophytic species were noted, and the substrate of the river bottoms, the stream width and depth, the current velocity, and the transparency and chemical composition of the water were characterized. An analysis was made of the relationships between river plant growth and the condition of the foregoing factors on the development of aquatic vegetation. (Author's abstract)
W87-01867

BIOLOGICAL ASSAY METHODS IN HYDROBIOLOGICAL STUDIES,
Gosudarstvennyi Gidrobiologii Inst., Leningard (USSR).
For primary bibliographic entry see Field 2D.
W87-01868

EFFECTS OF SUBSOILING AND IRRIGATION ON CORN PRODUCTION,
North Carolina State Univ. at Raleigh. Dept. of Soil Science.
For primary bibliographic entry see Field 2G.
W87-02029

POTENTIAL FOR EVOLUTION OF SALT (NACL) TOLERANCE IN SEVEN GRASS SPECIES,
Liverpool Univ. (England). Dept. of Botany.
M. Ashraf, T. McNeilly, and A. D. Bradshaw.
New Phytologist NEPHAV, Vol. 103, No. 2, p 299-309, June 1986. 3 fig, 4 tab, 21 ref.

Descriptors: *Salt tolerance, *Grasses, *Salt marshes, *Physiological ecology, Sodium chloride, Ecology, Seedlings, Roots, Growth, Vegetation.

The seedling root growth of seven grass species was examined after 14 days of immersion in dilute nutrient solutions containing NaCl. Root growth of all species was significantly reduced by increasing NaCl concentration. Seeds of each species were then screened for ability to root in solution cultures at NaCl concentrations which markedly inhibited root growth in the first experiment. Small numbers of individuals of all species rooted in these solutions, and high and low selection lines were established based upon root length values. Adult plants from these high and low selected lines were compared to an unselected sample for ability to root in a range of NaCl concentrations. The high line plants had significantly longer roots than the unselected plants in all species, and than the low selected line in all species except Agrostis capillaris. Low selected plants had significantly longer roots than unselected plants in Holcus lanatus and Dactylis glomerata. The pattern of response to selection showed no consistent relationship to the ecology of the species, and suggests that while variability in salt tolerance is widely present in species, salt tolerance does not always evolve in natural situations. (Author's abstract)
W87-02080

CONTRASTING RESPONSE TO SIMULATED ACID RAIN OF LEAVES AND COTYLEDONS OF CABBAGE (BRASSICA OLERACEA L.),
Toronto Univ. (Ontario). Dept. of Botany.
For primary bibliographic entry see Field 5C.
W87-02081

BETA-3-DIMETHYLSULPHONIOPROPIONATE, PROLINE AND QUATERNARY AMMONIUM COMPOUNDS IN SPARTINA ANGLICA IN RELATION TO SODIUM CHLORIDE, NITROGEN AND SULPHUR,
Vrije Univ., Amsterdam (Netherlands). Dept. of Ecology and Ecotoxicology.
J. van Diggelen, J. Rozema, D. M. J. Dickson, and R. Broekman.
New Phytologist NEPHAV, Vol. 103, No. 3, p 573-586, July 1986. 5 fig, 3 tab, 38 ref.

Descriptors: *Ammonium compounds, *Aquatic plants, *Proline, *Spartina, *Sodium chloride, *Nitrogen, *Sulfur, *Plant physiology, Growth, Nutrients, Nitrates, Salinity, Solutes, Accumulation, Salt marshes.

Spartina anglica seedlings were grown in nutrient solutions containing various concentrations of sodium salts as the chloride, sulfate, and sulfide. Two levels of nitrate were supplied to plants growing on the sodium chloride and sodium sulfate series. At low sodium chloride concentrations, higher growth rates were found in plants grown on the high nitrate level. At higher salinities, growth was inhibited and the inhibition was similar for plants grown on either nitrate level. Shoot levels of beta-3-dimethylsulphoniopropionate (DMSP) showed no significant increase with increasing sodium chloride concentrations at both nitrate levels. Levels of proline and quaternary ammonium compounds increased in response to sodium chloride, and were higher in plants grown on high nitrate. The influence of nitrogen availability on the accumulation of N-containing compatible solutes and growth is discussed. Growth rates of plants grown in increasing sodium sulfate concentrations were not inhibited. DMSP levels in plants did not increase with a sulfate increase in the medium. Plant growth was inhibited by sodium sulfide. Sulfate in the plant increased with increasing sulfide levels in the nutrient solution, and an increase of DMSP was found at the highest sulfide level. A possible function of DMSP as storage for excess sulfur is discussed. (Author' abstract)
W87-02084

EFFECTS OF VASCULAR AND NONVASCULAR MACROPHYTES ON SEDIMENT REDOX AND SOLUTE DYNAMICS,
Notre Dame Univ., IN. Dept. of Biological Sciences.
For primary bibliographic entry see Field 2H.
W87-02100

LUNAR CYCLE IN ZOOPLANKTON,
Warsaw Univ. (Poland). Dept. of Hydrobiology.
For primary bibliographic entry see Field 2H.
W87-02101

ESTABLISHMENT OF A SPARTINA ANGLICA POPULATION ON A TIDAL MUDFLAT: A FIELD EXPERIMENT,
Delta Inst. for Hydrobiological Research, Yerseke (Netherlands).
A. M. Groenendijk.
Journal of Environmental Management JEVMA,

Vol. 22, No. 1, p 1-12, January 1986. 5 fig, 3 tab, 29 ref.

Descriptors: *Spartina, *Tidal flats, *Wave action, *Sedimentation, Wave wash, Tidal currents, Tide lands, Netherlands, Elevation, Hydrodynamics, Plant growth, Seedlings, Barriers, Salt marshes, Erosion.

Spartina anglica seed was planted along an elevational gradient on an Oosterschelde mudflat to study the relationship between natural establishment and hydrodynamic and sediment transport processes and to determine whether spartina would spread naturally on the higher mudflats following construction of a storm surge barrier. The rate of seed loss was affected by elevation levels. Seedling establishment was found to be related to the germination rate in the initial phase of the growing season. There was no significant difference in seedling growth except at the lowest elevation levels. It was concluded that wave action was the main factor in controlling the natural spread of spartina. Since tidal reduction is not expected to moderate the intensity of the wave action, no large-scale invasion of the tidal mudflats by spartina is expected. (Michael-PTT)
W87-02115

EXPRESSION OF TOLERANCE OF NA(+), K(+), MG(2+), CL(-), AND SO4(2-) IONS AND SEA WATER IN THE AMPHIPLOID OF TRITICUM AESTIVUM ELYTRIGIA ELONGATA,
California Univ., Davis. Dept. of Agronomy and Range Science.
J. Dvorak, and K. Ross.
Crop Science CRPSAY, Vol. 26, No. 4, p 658-660, July-August 1986. 2 tab, 16 ref. USDA CRGO Grant 81-CRCR-1-0635.

Descriptors: *Salt tolerance, *Seawater, *Wheat, *Ions, Salinity, Sodium, Potassium, Magnesium, Chlorine, Sulfates, Genetic engineering, Plant growth, Seeds, Crop yield.

The salt tolerance of two wheat related plant species, Triticum aestivum 'Chinese Spring' and an amphiploid of T. aestivum, was investigated to determine the possibility of transferring salt tolerance to other wheat strains through genetic engineering. Plants were maintained in hydroponic tanks during their life span and their survival, production of dry matter and seed yield were determined. The amphiploid was more tolerant to every salt tested and outyielded 'Chinese Spring' in both dry matter per plant and seed production. (Michael-PTT)
W87-02126

INFLUENCE OF DRAINAGE ON N-MINERALIZATION AND VEGETATION RESPONSE IN WET MEADOWS: II. CIRSIO-MOLINIETUM STANDS,
Groningen Rijksuniversiteit (Netherlands). Dept. of Plant Ecology.
A. P. Grootjans, P. C. Schipper, and H. J. van der Windt.
Acta Ecologica AOSPDY, Vol. 7, No. 1, p 3-14, 1986. 3 fig, 3 tab, 39 ref.

Descriptors: *Drainage effects, *Nitrogen, *Mineralization, *Meadows, *Peat bogs, *Plant growth, Absorption, Accumulations, Phosphorus, Drought, Groundwater availability, Netherlands, Fertilization, Water stress, Nutrients.

Nitrogen mineralization rates and phosphate availability were analyzed in two Cirsio-Molinietum meadows on Netherlands fen peats with a high percentage of total nitrogen to study nutrient limitation in unfertilized fen meadows. Only one meadow was affected by drainage. Nitrogen mineralization in the drained peat fen was two to three times higher than in undrained peat, but vegetation did not respond with increased yields. Produced NO3(-) was not absorbed by plant roots and accumulated in top soil, indicating that plant growth was not limited by nitrogen. Phosphorus limitation and/or water stress could have contributed to low yield under very dry conditions because phosphorus availability was repressed during periods of drought. (Michael-PTT)
W87-02134

WATER USE, FOLIAGE TEMPERATURE AND YIELD OF IRRIGATED WHEAT IN SOUTH-EASTERN AUSTRALIA,
Agricultural Research Service, Bushland, TX. Conservation and Production Lab.
For primary bibliographic entry see Field 3F.
W87-02136

EFFECTS OF POST-TRANSPLANT WATER DEFICITS ON LEAF DEVELOPMENT AND YIELD OF WINTER PLANTED TOBACCO IN NORTH QUEENSLAND,
Queensland Dept. of Primary Industries,Mareeba (Australia). Southedge Tobacco Research Station.
K. H. Ferguson, S. Fukai, G. L. Wilson, and M. A. Toleman.
Australian Journal of Agricultural Research AJAEA9, Vol. 36, No.1, p 51-61, 1985. 6 fig, 2 tab, 16 ref.

Descriptors: *Water deficit, *Crop yield, *Tobacco, *Plant growth, *Transplantation, Australia, Irrigation, Leaves.

The effect of water deficit on floral initiation, leaf development and plant yield of commercial leaf tobacco was studied in northern Queensland, Australia. The deficits were induced by different watering treatments at transplantation combined with a range of times during which irrigation was withheld after transplanting. The effects of two water deficit periods on flower and leaf development was separately studied in a pot experiment in a controlled environment. Post-tranplantation water deficits delayed floral initiation and allowed more leaves to be produced. The size of most commerical value leaves was increased by water deficit. Withholding water for two days following transplanting increased the area and dry weight of commercial yield per plant by 33%. Pot experiment data showed that larger leaf area resulted from an extended period of linear growth and a greater expansion rate after water deficits were relieved. (Michael-PTT)
W87-02137

ROOT CHARACTERISTICS OF SOME TEMPERATE LEGUME SPECIES AND VARIETIES ON DEEP, FREE-DRAINING ENTISOLS,
Western Australia Dept. of Agriculture, South Perth. Plant Research Div.
A. P. Hamblin, and J. Hamblin.
Australian Journal of Agricultural Research AJAEA9, Vol. 36, No. 1, p 63-72, 1985. 2 fig, 5 tab, 24 ref.

Descriptors: *Root development, *Legumes, *Water use efficiency, *Sand, *Nutrient requirements, Root distribution, Plant growth, Topsoil, Australia, Root zone.

Several legumes were compared to distinguish genotypic from environmental variations in root parameters which influence water use and nutrition. Temperate crop and pasture legumes were grown in three xeric psamment soils in western Australia to evaluate relative root characteristics of different species. Several sites had rainfall during the winter growing season. Maximum root depth differed between genotypes, but was insignificant between sites. This implied a genetic control which may influence water use and plant production in low water storage sandy soils. Less than 50% of lupins and wheat total root length were in the top 20 centimeters of the soil layer while all other species had over 70% of roots in that layer. Pasture legumes with high root density in the top layer tended to dry sandy topsoils frequently, thus reducing nutrient availability and vegetative growth. All total root lengths were low at maturity, but were adequate for water and mobile nutrient extraction from sandy soils. (Michael-PTT)
W87-02138

FURROW IRRIGATION OF GRAIN SORGHUM IN A TROPICAL ENVIRONMENT. I. INFLUENCE OF PERIOD OF INUNDATION AND NITROGEN FERTILIZER ON DRY MATTER PRODUCTION, GRAIN YIELD AND SOIL AERATION,
Queensland Dept. of Primary Industries,Mareeba (Australia). Southedge Tobacco Research Station.
G. C. Wright.
Australian Journal of Agricultural Research AJAEA9, Vol. 36, No. 1, p 73-82, 1985. 5 fig, 4 tab, 23 ref.

Descriptors: *Sorghum, *Furrow irrigation, *Water use efficiency, *Nitrogen, *Fertilization, Irrigation practices, Crop yield, Plant growth, Soil porosity, Drainage, Flood irrigation, Soil aeration, Australia.

The effect of applied nitrogen and furrow irrigation inundation periods on grain sorghum growth and yield was studied in Australia. Water was run in furrows for various periods every seven to ten days during the dry season. Increasing the inundation period reduced grain yield for nitrogen-fertilized crops. Air-filled porosity of the soil recovered more slowly as the inundation period was increased. The time required to reach an air-filled porosity of zero to ten at the 10-20 centimeter depth was highly correlated with grain yield. Results indicated that grain yield is strongly influenced by the duration of waterlogging associated with flood irrigation. Irrigated crops should be drained rapidly to minimize yield losses and reduce the duration and severity of soil anaerobiosis. (See also W87-02140) (Michael-PTT)
W87-02139

FURROW IRRIGATION OF GRAIN SORGHUM IN A TROPICAL ENVIRONMENT. II. INFLUENCE OF PERIOD OF INUNDATION ON THE UTILIZATION OF SOIL AND FERTILIZER NITROGEN BY THE CROP,
Commonwealth Scientific and Industrial Research Organization, Kununurra (Australia). Kimberley Research Station.
G. C. Wright.
Australian Journal of Agricultural Research AJAEA9, Vol. 36, No. 1, p 83-89, 1985. 4 fig, 2 tab, 16 ref.

Descriptors: *Sorghum, *Furrow irrigation, *Water use efficiency, *Nitrogen, *Fertilization, Irrigation practices, Denitrification, Leaching, Nitrates, Accumulation.

Grain sorghum was grown in plots that had been fertilized with nitrogen before sowing and furrow irrigated for various periods. Apparent uptake of fertilizer nitrogen declined as the incubation period increased. Higher quantities of nitrogen remained in surface soil of all furrow irrigated ridges at crop maturity in contrast to the sprinkler irrigated ridges. A constant proportion of applied nitrogen was moved to the ridge tops at all inundation periods. Differences in applied nitrogen recovery between crops given zero (sprinkler) and three hours of furrow irrigation was attributed to surface accumulation of nitrate. Reduced nitrogen uptake following longer inundation periods was due to different rates of nitrogen loss because of denitrification and leaching. (See also W87-02139) (Author's abstract)
W87-02140

EFFECT OF SOWING TIME ON GROWTH, YIELD AND WATER-USE OF RAIN-FED WHEAT IN THE WIMMERA, VIC.,
Victoria Dept. of Agriculture, Werribee (Australia). Animal Research Inst.
For primary bibliographic entry see Field 3F.
W87-02142

GENETIC VARIATION IN SODIUM AND POTASSIUM CONCENTRATION IN HERBAGE OF DIGITARIA MILANJIANA, AND ITS RELATION TO PROVENANCE,
Commonwealth Scientific and Industrial Research Organization, St. Lucia (Australia). Div. of Tropical Crops and Pastures.
J. B. Hacker, R. W. Strickland, and K. E. Basford.

Australian Journal of Agricultural Research AJAEA9, Vol. 36, No. 2, p 201-212, 1985. 4 fig, 6 tab, 43 ref.

Descriptors: *Sodium, *Potassium, *Provenance, *Grasses, *Accumulation, *Genetic engineering, *Adaptation, Geography, Coastal areas, Inland areas, Vegetation regrowth, Semiarid lands, Pastures, Australia, Accumulation, Pastures, Distribution.

Sodium and potassium concentrations in accessions of the African grass Digitaria milanjiana were studied to determine the adaptive significance of sodium accumulation and the possibility of breeding D. milanjiana cultivars that have an adequate sodium concentration and can be adapted to low rainfall areas. Sixty-five accessions were grown in a grass garden in Queensland, Australia and sodium and potassium concentrations of herbage were determined after six week and six month regrowth periods. Sodium concentration was inversely correlated with potassium concentration, and there was a defined geographic distribution of accessions which had high or low sodium concentrations. Coastal site accessions had high concentrations, while those from inland sites south and north of 20 degrees latitude south had either low or very low concentrations of sodium in dry matter. Genetic studies at the diploid level showed different patterns of inheritance of sodium and potassium concentrations for two crosses even with one common parent. Additive and dominance effects were evident and significant inter-allelic interactions occurred, especially involving dominance. Breeding of an adapted pasture variety for inland low rainfall areas would require input of inland genes governing appropriate dormancy mechanisms and coastal genes controlling sodium uptake. (Michael-PTT)
W87-02143

COMPARATIVE TOLERANCE OF TROPICAL GRAIN LEGUMES TO SALINITY,
Commonwealth Scientific and Industrial Research Organization, St. Lucia (Australia). Div. of Tropical Crops and Pastures.
For primary bibliographic entry see Field 3C.
W87-02144

GERMINATION AND GROWTH OF SECALE MONTANUM GUSS. IN THE PRESENCE OF SODIUM CHLORIDE,
Victoria Dept. of Agriculture, Tatura (Australia). Irrigation Research Inst.
For primary bibliographic entry see Field 3C.
W87-02145

GROWTH AND MINERAL COMPOSITION OF THE SULTANA GRAPEVINE AS INFLUENCED BY SALINITY AND ROOTSTOCK,
Commonwealth Scientific and Industrial Research Organization, Adelaide (Australia). Div. of Horticultural Research.
For primary bibliographic entry see Field 3C.
W87-02146

COMPARATIVE RESPONSE TO SALINITY OF THE GROWTH AND NODULATION OF MACROPTILIUM ATROPURPUREUM CV. SIRATRO AND NEONOTONIA WIGHTII CV. COOPER SEEDLINGS,
Commonwealth Scientific and Industrial Research Organization, St. Lucia (Australia). Div. of Tropical Crops and Pastures.
For primary bibliographic entry see Field 3C.
W87-02147

REJUVENATION OF MELOSIRA GRANULATA (BACILLARIOPHYCEAE) RESTING CELLS FROM THE ANOXIC SEDIMENTS OF DOUGLAS LAKE, MICHIGAN. I. LIGHT MICROSCOPY AND 14C UPTAKE,
Michigan Univ., Ann Arbor. Great Lakes Research Div.
For primary bibliographic entry see Field 2H.
W87-02168

REJUVENATION OF MELOSIRA GRANULATA (BACILLARIOPHYCEAE) RESTING CELLS FROM THE ANOXIC SEDIMENTS OF DOUGLAS LAKE, MICHIGAN. II. ELECTRON MICROSCOPY,
Michigan Univ., Ann Arbor. Great Lakes Research Div.
For primary bibliographic entry see Field 2H.
W87-02169

CHANGES IN LEAF WATER POTENTIAL AND CAM IN SEMPERVIVUM MONTANUM AND SEDUM ALBUM IN RESPONSE TO WATER AVAILABILITY IN THE FIELD,
Victoria Univ. of Manchester (England). Dept. of Botany.
M. J. Earnshaw, K. A. Carver, and J. A. Lee.
Oecologia OECOBX, Vol. 67, No. 4, p 486-492, November 1985. 6 fig, 29 ref.

Descriptors: *Leaf water potential, *CAM plants, *Water availability, Leaf temperature, Spanish Pyrenees, Photosynthesis, Nocturnal acidification, Light intensity.

The short term effects of irrigation on diurnal changes in Psi leaf and titratable acidity have been examined both in Sempervivum montanum and in Sedum album, a faculative CAM plant, in the Spanish Pyrenees. In Sempervivum, the Psi leaf responded rapidly to irrigation and, increased during the day and decreased during the night and early morning. Psi leaf in Sedum responded more slowly to irrigation and showed a decrease during the day and an increase in the period between evening and early morning. Under the conditions of the short-term experiments, changes in acid metabolism had not been observed in either species following irrigation. Transpirational water loss together with redistribution of water within the plant are more important than the osmotic concentration of malic acid in determining Psi leaf in both species and that daytime water loss were greater in Sedum than in Sempervivum. The effect of long-term water stress on Psi leaf and acid levels were also assessed in both species over a 3-week period. Both Psi leaf and acidification in Sempervivum decreased over this time period. In Sedum, Psi leaf also declined, but a more gradual reduction in acidification occurred. Nocturnal acidification in the irrigated plants were lower than in the non-irrigated control. It was suggested in Sedum album that C3 photosynthesis during the preceding light period, as determined by light intensity and leaf temperature, could have been important in determining the extent of nocturnal acidification under field conditions. (Author's abstract)
W87-02179

RELATIVE SALT TOLERANCE OF CAKILE EDENTULA (BRASSICACEAE) FROM LACUSTRINE AND MARINE BEACHES,
California Univ., Davis. Dept. of Botany.
R. S. Boyd, and M. G. Barbour.
American Forests Journal of Botany AJBOAA, Vol. 73, No. 2, p 236-241, February 1986. 4 fig, 1 tab, 24 ref.

Descriptors: *Salt tolerance, *Lacustrine plants, *Marine plants, *Beaches, Plants, Pacific Ocean, Lake Huron, Washington, Ontario, Aquatic plants.

Seeds of Cakile edentula ssp. edentula var. edentula had been collected from the Pacific Ocean shore of Washington, and Cakile edentula ssp. edentula var. lacustris seeds were collected from the Lake Huron shore of Ontario. Germination rates of the two varieties showed equal tolerance of substrate salinities ranging from 0-10,000 ppm. Early root growth of edentula seedlings was significantly stimulated by 1,000 ppm salts, but both varieties showed equal tolerance to 10,000 ppm. Edentula plants had been exposed for 4 weeks to salt spray intensities of 0, 20 and 90 mg/sq dm/d, showed no significant changes in shoot or root biomass, plant morphology, or reproductive effort. Lacustris plants exhibited a significant decline in stem length and reproductive effort with increasing levels of salt spray. Lacustris and edentula have diverged physiologically over the past 9,000 years, and field observations from the literature corroborate the conclusion made here that the divergence in salt tolerance has ecological significance. (Author's abstract)
W87-02182

PROGENY SCREENING OF SORGHUM PLANTS REGENERATED FROM SODIUM CHLORIDE - SELECTED CALLUS FOR SALT TOLERANCE,
Texas A and M Univ., College Station. Dept. of Soil and Crop Sciences.
For primary bibliographic entry see Field 3C.
W87-02183

GLASSHOUSE SCREENING PROCEDURE FOR IDENTIFYING CITRUS HYBRIDS WHICH RESTRICT CHLORIDE ACCUMULATION IN SHOOT TISSUES,
Commonwealth Scientific and Industrial Research Organization, Merbein (Australia). Div. of Horticultural Research.
For primary bibliographic entry see Field 3C.
W87-02222

WATER AVAILABILITY AND THE COMPARATIVE EMERGENCE OF FOUR CONIFER SPECIES,
New Brunswick Univ., Fredericton.
P. A. Thomas, and R. W. Wein.
Canadian Journal of Botany CJBOAW, Vol. 63, No. 10, p 1740-1746, October 1985. 5 fig, 2 tab, 27 ref.

Descriptors: *Conifers, *Water deficit, *Plant growth, Vegetation regrowth, Charred organic matter, Forest fires, Soil moisture deficiency, Soil water, Drought resistance, Pine trees.

Emergence of four conifer species was observed in greenhouse seedbeds watered at different frequencies to evaluate the hypothesis that seedlings of some species require shelter from direct sunlight to slow the rate of drying in charred organic matter seedbeds. Emergence from infrequently watered seedbeds was higher in jack pine than in eastern white pine, and lowest in black spruce and the balsam fir. The order is similar in the ability to emerge without shelter on postfire seedbeds. Coping with fluctuating moisture availability was determined to be a major factor in conifer establishment on this harsh seedbed. Seeds were also germinated in solutions of polyethylene glycol. These data and measurements of resistance to and tolerance of water loss suggest that eastern white pine succeeds because preemergent seedlings can tolerate desiccating conditions. Measurements of radicle elongation rates indicate that jack pine succeeds by evading periods of low water availability. (Michael-PTT)
W87-02256

SEEDLING RECRUITMENT OF 11 WETLAND PLANT SPECIES ALONG A WATER LEVEL GRADIENT: SHARED OR DISTINCT RESPONSES,
P. A. Keddy, and T. H. Ellis.
Canadian Journal of Botany CJBOAW, Vol. 63, No. 10, p 1876-1879, October 1985. 1 fig, 1 tab, 28 ref. NSERC (Canada) Grant A8534.

Descriptors: *Water level, *Seedlings, *Plant growth, *Wetlands, Plant populations, Recruitment, Germination.

Seedling germination and emergence of 11 wetland plant species along a water level gradient was studied to determine whether maximum recruitment occurs in the same ('shared responses') or different ('distinct responses') regions of the gradient. Seeds were allowed to germinate in sand along a gradient of water depth ranging from 10 centimeters above to five centimeters below the substrate surface. Five species showed no significant response to the gradient, but in the six species that did respond, there was no indication of shared preferences along the water depth gradient. The different recruitment patterns were consistent with adult distributions in the field. Most species

showed some recruitment at all water levels examined which suggests that they have broad tolerance for water level in the recruitment phase. (Michael-PTT)
W87-02257

ATMOSPHERIC CO2 ENRICHMENT OF WATER HYACINTHS: EFFECTS ON TRANSPIRATION AND WATER USE EFFICIENCY,
Agricultural Research Service, Phoenix, AZ. Water Conservation Lab.
S. B. Idso, B. A. Kimball, and M. G. Anderson.
Water Resources Research WRERAO, Vol. 21, No. 11, p 1787-1790, November 1985. 4 fig, 18 ref. Interagency agreement DE AI01-81ER60001.

Descriptors: *Carbon dioxide, *Water hyacinths, *Water use efficiency, *Transpiration, Enrichment, Biomass, Plant growth, Aquatic plants.

The effects of atmospheric CO2 enrichment on transpiration and water use efficiency in water hyacinth was studied. A full cover of water hyacinths was maintained outdoors in sunken metal stock tanks enclosed by open-top clear plastic wall chambers. One chamber represented ambient conditions and the other three were continuously enriched with CO2 to approximate three target concentrations. During a four week maximum plant growth period, biomass production increased by 36% and water use efficiency doubled when atmospheric CO2 was doubled. These results are similar to observations of several terrestrial plants and indicate the general trend which might be expected to occur as atmospheric CO2 continues to rise in the future. (Michael-PTT)
W87-02294

EXPERIMENTAL STUDIES TO THE AUTOECOLOGY OF GROENLANDIA DENSA (EXPERIMENTELLE UNTERSUCHUNGEN ZUR AUTOKOLOGIE VON GROENLANDIA DENSA),
Hohenheim Univ., Stuttgart (Germany, F.R.). Inst. fuer Landeskultur und Pflanzenokologie.
For primary bibliographic entry see Field 2H.
W87-02336

EFFECTS OF URBANIZATION ON LANDSCAPE ELEMENTS AND WOODLAND COVER,
For primary bibliographic entry see Field 4C.
W87-02558

2J. Erosion and Sedimentation

ORIENTATION OF CLAMSHELLS AS A VELOCITY INDICATOR IN A CANAL,
Water and Power Resources Service, Sacramento, CA. Mid-Pacific Region.
For primary bibliographic entry see Field 2E.
W87-01842

EFFECTS OF PLACER GOLD MINING ON PRIMARY PRODUCTION IN SUBARTIC STREAMS OF ALASKA,
Alaska Univ., Anchorage. Arctic Environmental Information and Data Center.
For primary bibliographic entry see Field 5B.
W87-01892

BEDLOAD TRANSPORT IN A POOL-RIFFLE SEQUENCE OF A COASTAL ALASKA STREAM,
Oregon State Univ., Corvallis.
A. J. Campbell, and R. C. Sidle.
Water Resources Bulletin WARBAQ, Vol. 21, No. 4, p 579-590, August 1985. 9 fig, 22 ref.

Descriptors: *Sediment transport, *Bed load discharge, *Riffles, *Salmon, Sediments, Bambi Creek, Trap Creek watershed, Alaska, Scour.

The processes of bedload routing and storage in a small coastal Alaska salmon stream were described and quantified. A Helley-Smith pressure differential bedload sampler was used to measure bedload transport at consecutive riffle sections of a riffle-pool-riffle sequence on Bambi Creek, a small (154 ha), second-order stream on Chichagof Island, Alaska, during four storms over a 2-year period. Bambi Creek is 2570 m long, and the elevation ranges from 5 m to 614 m above sea level. Trap Bay has a northern maritime climate characterized by cool summers and relatively mild winters. Average annual precipitation is believed to be significantly higher at Trap Bay because of orographic influences and exposure. Maximum bedload transport rate measured was 4920 kg/h at a stream flow of 2.34 cu m/s corresponding to a storm having a 5-year return interval. Transport of larger sediment (>8 mm) varied systematically with streamflow at the two sampling locations. At flows up to approximately bankfull, transport of large sediment was greatest at the upstream site; at flows above bankfull, transport of large sediment was greatest at the downstream site. The net import of large sediment to the pool during moderate stormflows and net export of sediment to the pool during moderate stormflows and net export of large sediment from the pool during flows above bankfull may be related to a 'convergence' or 'reversal' of competence between the upstream riffle and subsequent pool at flows approximating bankfull stage. Cross-sections monitored within the study reach indicate that stormflows resulted in net filling of the riffle sections and net scour of the pool; periods of low streamflow resulted in net scour of the riffles and net filling of the pool. (Peters-PTT)
W87-01899

REVERSIBLE ADSORPTION OF AQUEOUS DIVALENT COPPER ION BY ESTUARINE SEDIMENTS,
Auburn Univ., AL. Dept. of Chemistry.
For primary bibliographic entry see Field 2L.
W87-01919

TECHNIQUE FOR MEASURING SCOUR AND FILL OF SALMON SPAWNING RIFFLES IN HEADWATER STREAMS,
Weyerhaeuser Co., Tacoma, WA. Environmental Forestry Research.
S. H. Duncan, and J. W. Ward.
Water Resources Bulletin WARBAQ, Vol. 21, No. 3, p 507-511, June 1985. 3 fig, 1 tab, 10 ref.

Descriptors: *Scour, *Spawning, *Sediment transport, *Channel morphology, *Riffles, Salmon, Washington, Fall River, Willapa Bay, Thrash Creek, Chehalis River, Stream fill monitoring, Channels, Landslides, Organic debris, Gravel.

A technique that could be used to monitor change caused by high discharge events was developed and tested as an aid to indexing stability of salmonid spawning gravels in headwater streams. Two streams in the coast range of Washington State known to have spawning runs of late fall and winter coho salmon (O. kisutch) were chosen: Fall River, as tributary of Willapa Bay, and Thrash Creek, a tributary to the Chehalis River system. A 30 x 0.9 cm piece of steel rod bent in the shape of an 'L' and attached by hose clamps to a 15 x 3.2 cm section of plastic pipe sliding on an 86 x 1.9 cm steel shaft was tested for use in measuring scour and fill of salmon spawning riffles. Installed along channel cross-sections, results of tests at four sites on two hydraulically different streams showed the device to be useful in monitoring event specific scour and fill. The Thrash Creek sites reflect the relative instability and variation in a channel subjected to large inputs of landslide materials and removal of organic debris. For the same relative increases in stream flow, the sites at Thrash Creek are more actively in motion than the more stable Fall River site. However, because of the range in average salmonid egg burial (9-26 cm), presumably sufficient change occurred at both sites to affect survival. Although many more sites composed of varying gravel sizes and channel characteristics should be examined to thoroughly evaluate this device, it proved to be an adequate minimum disturbance system for monitoring spawning riffles of the gravel composition in which it was tested. (Peters-PTT)
W87-01925

PATTERNS OF SUSPENDED SEDIMENT TRANSPORT IN A COASTAL ALASKA STREAM,
Pacific Northwest Forest and Range Experiment Station, Juneau, AK. Forestry Sciences Lab.
R. C. Sidle, and A. J. Campbell.
Water Resources Bulletin WARBAQ, Vol. 21, No. 6, p 909-917, December 1985. 6 fig, 2 tab, 34 ref.

Descriptors: *Sediment transport, *Suspended solids, *Turbidity, *Regression analysis, Chichagof Island, Alaska, Storms, Sediments, Hydrographs, Hysteresis loops, Organic debris, Bambi Creek, Trap Bay, Precipitation.

Suspended sediment data from a 154 ha watershed on northeast Chichagof Island, Alaska, were collected over three fall storm seasons from 1980 to 1982. The research on sedimentation was conducted along the lower reaches of Bambi Creek, a second-order stream within the Trap Bay watershed. Climate is typical of coastal Alaska, with cool summers, high rainfall during fall, and early winter, intermittent snow at lower elevations and a more consistent snowpack above 400 m during winter and early spring, and moderate rainfall in spring. Water samples for suspended sediment and turbidity analyses were collected with an Instrument Specialties Company Model 1680 automatic pumping sampler. Sediment rating curves for nine pooled storms explained less than 34 percent of the variation in total suspended solids (TSS). Significantly higher concentrations of suspended sediment occurred during the rising limb of storm hydrographs than for similar flows on the falling limb, accounting for hysteresis loops in TSS versus streamflow plots for individual storms. These hysteresis loops were wider during early season storms, indicating that easily transportable fine sediment may have been flushed from the upper portion of channel banks and from behind large organic debris during early season peak flows. Regression relationships (TSS versus Q) developed for the highest streamflows had steeper slopes than the lower stormflows. Turbidity correlated well with TSS for all stormflow data combined. Organic matter constituted an average of 35 percent (by weight) of TSS for all water quality samples. Results from this study can be applied to the design of appropriate monitoring schemes for sediment transport in small forest streams in similar terrain. Since the majority of sediment transport occurs during fall storms in coastal Alaska, frequent sampling during these storms is needed to characterize transport of suspended sediment. Quantification of suspended organic solids, which may be important in terms of aquatic habitat, requires even more intense sampling than mineral suspended sediment because of the higher variability associated with organic solids. (Peters-PTT)
W87-01926

LONG-TERM PATTERNS OF WATER QUALITY IN A MANAGED WATERSHED IN OREGON: 1. SUSPENDED SEDIMENT,
Weyerhaeuser Co., Tacoma, WA. Environmental Sciences and Technology Dept.
For primary bibliographic entry see Field 4C.
W87-01932

BEDROCK CONTROLS ON STREAM CHANNEL ENLARGEMENT WITH URBANIZATION, NORTH CENTRAL TEXAS,
Baylor Univ., Waco, TX. Dept. of Geology.
P. M. Allen, and R. Narramore.
Water Resources Bulletin WARBAQ, Vol. 21, No. 6, p 1037-1048, December 1985. 18 fig, 6 tab, 41 ref.

Descriptors: *Watersheds, Urban Hydrology, Geomorphology, *Channel erosion, *Shales, Hydrogeomorphology, Dallas, Texas, Chalk, Channel enlargement, Urbanization, Vegetation.

Loss due to channel erosion in the Dallas, Texas, area is estimated to approach one-half million dollars in the last several years. Hydrogeomorphic analysis of natural and urban chalk and shale watersheds was performed in the central Texas area on watersheds ranging in size from 0.5 to 10 sq mi

in an effort to more adequately predict channel enlargement due to urbanization. Chalk watersheds were found to have greater drainage density, greater channel slope, lower sinuosity, and greater discharge per unit area than similar sized shale watersheds under natural conditions. With subsequent urbanization of the watersheds, chalk channel enlargement was from 12 to 67 percent greater than shale channel enlargement for similar sized watersheds. Greater enlargement in chalk channels is attributed to greater channel velocities and unit tractive force. Vegetation seems to play a significant role in influencing channel adjustments to the new flow regimes brought on by urbanization. Channel response to urbanization is documented and specific nonstructural guidelines are proposed which could reduce structural loss along urban stream channels. (Author's abstract)
W87-01939

DOMINANT PROCESSES OF SEDIMENT DISTRIBUTION AND FOCUSING IN A SMALL, EUTROPHIC, MONOMICTIC LAKE,
Freshwater Biological Association, Ambleside (England).
For primary bibliographic entry see Field 2H.
W87-01978

MECHANISTIC, NUMERICAL MODEL OF SEDIMENTATION, MINERALIZATION, AND DECOMPOSITION FOR MARSH SEDIMENTS,
South Carolina Univ., Columbia. Dept. of Biology.
For primary bibliographic entry see Field 2L.
W87-01989

EROSION-SEDIMENTATION IN A CLOSED DRAINAGE BASIN IN NORTHWEST INDIANA,
National Soil Erosion Lab., West Lafayette, IN.
For primary bibliographic entry see Field 4D.
W87-01998

DEPTH OF SURFACE SOIL-RUNOFF INTERACTION AS AFFECTED BY RAINFALL, SOIL SLOPE, AND MANAGEMENT,
Agricultural Research Service, Durant, OK. Water Quality and Watershed Research Lab.
A. N. Sharpley.
Soil Science Society of America Journal SSSJD4, Vol. 49, No. 4, p 1010-1015, July-August 1985. 6 fig, 4 tab, 15 ref.

Descriptors: *Runoff, *Soil water, *Rainfall-runoff relationships, *Soil erosion, *Management planning, *Slopes, *Runoff, Pesticides, Statistical analysis, Adsorption, Chemical analysis, Phosphorus, Soil aggregates, Mathematical analysis.

The effective depth of interaction (EDI) between surface soil and runoff was determined for five soils of varying physical and chemical properties to quantify the effect of rainfall and soil characteristics on EDI. EDI increased with an increase in rainfall intensity and soil slope for all soils. The former was attributed to increased runoff energy facilitating the mixing in the surface soil and was also a function of soil aggregation while the latter was simply a function of runoff energy alone. An average 73% reduction in EDI followed the incorporation of 100kg of wheat straw/ha, and an 80% reduction with a 0.5-sq millimeter mesh screen simulating crop cover was obtained. For all soils, the logarithm (ln) of soil loss was related to ln EDI. Regression slopes for the logarithm relationships were similar, and regression intercepts were related, to soil aggregation. Thus EDI and the effect of rainfall and soil management could be related to soil loss. This relationship can improve the prediction of adsorbed chemical (P and pesticides) transport in solution, since chemical transport models presently use a fixed EDI value. (Khumbatta-PTT)
W87-02031

RIVER DYNAMICS AND THE DIVERSITY OF AMAZON LOWLAND FOREST,
Turku Univ. (Finland). Dept. of Biology.
For primary bibliographic entry see Field 2E.
W87-02077

CHEMICAL QUALITY OF SUSPENDED SEDIMENT FROM WATERSHEDS SUBJECTED TO SURFACE COAL MINING,
Ohio Agricultural Research and Development Center, Wooster.
For primary bibliographic entry see Field 5B.
W87-02094

SULFUR AND CARBON ISOTOPES AS TRACERS OF SALT-MARSH ORGANIC MATTER FLOW,
Marine Biological Lab., Woods Hole, MA. Ecosystems Center.
For primary bibliographic entry see Field 2G.
W87-02099

DETERMINATION OF ERODABILITY OF A SUBTROPICAL CLAY SOIL: A LABORATORY RAINFALL SIMULATOR EXPERIMENT,
Institute of Agricultural Engineering, Harare (Zimbabwe).
H. A. Elwell.
Journal of Soil Science, Vol. 37, No. 2, p 345-350, June 1986. 2 fig, 5 tab, 12 ref.

Descriptors: *Soil erosion, *Clay, *Tropical regions, *Simulated rainfall, *Land use, Soil aggregates, Organic carbon, Runoff forecasting, Mathematical equations, Regression analysis.

The erodability of a well-drained clay soil derived from igneous rock in Zimbabwe was determined using a laboratory rainfall simulator. Soil indices were established by which changes in erodability could be monitored. Results of regression analysis indicated that mean weight diameter of water-stable aggregates was significant in explaining variations in soil loss and runoff. Organic carbon in the soil accounted for the proportion of water-stable aggregates. It is suggested that these soil indices can be used to aid management decisions regarding the use of arable and grazing land of this soil type. (Michael-PTT)
W87-02119

MODEL FOR PARTICLE-SELECTIVE TRANSPORT OF TRACERS IN SEDIMENTS WITH CONVEYOR BELT DEPOSIT FEEDERS,
National Oceanic and Atmospheric Administration, Ann Arbor, MI. Great Lakes Environmental Research Lab.
For primary bibliographic entry see Field 2H.
W87-02124

MODELING RADIOTRACERS IN SEDIMENTS: COMPARISON WITH OBSERVATIONS IN LAKE HURON AND MICHIGAN,
Wisconsin Univ.-Milwaukee. Dept. of Civil Engineering.
E. R. Christensen, and P. K. Bhunia.
Journal of Geophysical Research (c) JGRCEY, Vol. 91, No. 7, p 8559-8571, July 15, 1986. 11 fig, 10 tab, 23 ref. EPA Assistance agreement R810419.

Descriptors: *Bottom sediments, *Bottom water, *Isotopic tracers, *Lake Huron, *Lake Michigan, Mathematical models, Mathematical equations, Lead radioisotopes, Cesium radioisotopes, Microorganisms, Advection, Diffusion, Fluctuations, Water-sediment interface.

Radionuclide activity in sediments is modeled based on advection-diffusion equations for a radioactive tracer. Model application is demonstrated by literature data for sediment cores from Lake Huron and Lake Michigan. Mixing resulting from deposit feeding is reflected by a half-Gaussian, integrated Gaussian and exponential diffusion coefficient with a maximum value at the sediment-water interface and an effective mixing depth. Compaction is expressed as an exponential bulk sediment density. Differential equations are solved by finite differences, including the Crank-Nelson method for determing the time-dependent profile of cesium 137. Mixing parameters and mixing depth are estimated by minimizing chi-squared for measured and calculated 210-Pb activity. The derived mixing depths for cores from Lake Huron agree with those inferred from densities of Pantoporeia and tubificid oligochaetes. There appears to be less sediment focusing in northern Lake Micigan where ratios of measured 137-Cs inventories have an average value of 0.89 and range from 0.32 to 1.41 for six cores from the deep basin. There ratios are used to correct 210-Pb fluxes. This model appears to be an improvement over previous models because of its more realistic activity profiles. (Michael-PTT)
W87-02125

CHARACTERISTICS OF HIGH-ENERGY MEANDERING RIVERS: THE CANTERBURY PLAINS, NEW ZEALAND,
McGill Univ., Montreal (Quebec). Dept. of Geography.
For primary bibliographic entry see Field 2E.
W87-02129

CONTAMINATED SEDIMENTS OF LAKES AND OCEANS ACT AS SOURCES OF CHLORINATED HYDROCARBONS FOR RELEASE TO WATER AND ATMOSPHERE,
Lund Univ. (Sweden). Limnological Inst.
For primary bibliographic entry see Field 5B.
W87-02174

SEASONAL VARIABILITY AND GEOCHEMICAL SIGNIFICANCE OF ORGANIC MATTER IN THE RIVER GANGES, BANGLADESH,
Hamburg Univ. (Germany, F.R.). Inst. of Geology and Paleontology.
V. Ittekkot, S. Safiullah, B. Mycke, and R. Seifert.
Nature NATUAS, Vol. 317, No. 6040, p 800-802, October 31, 1985. 3 fig, 1 tab, 28 ref.

Descriptors: *Organic matter, *River Ganges, *Bangladesh, *Geochemistry, Sediment load, Sedimentation, Settling.

Asian rivers particularly those originating in the Himalayas, significantly contribute to the annual global sediment discharge from the land to the sea. However, a little is known about their organic matter load. By studying the Ganges-Brahmaputra river system at locations in Bangladesh, with sampling intervals of 4 to 6 weeks, report on the seasonal variability of organic matter in the dissolved and suspended loads of the Ganges during 1981, was revealed by data on particulate and dissolved organic carbon (POC and DOC) respectively, and their constituent fractions such as sugars, amino acids and n-alkanes. Organic matter associated with peak sediment dishcarge (July to November) appeared to be dominated by a biodegraded fraction, also resulting from biogeochemical processes occuring in the oxbow lakes in Bangladesh and, were less susceptible to further decomposition upon reaching the marine environment. The rivers such as the Ganges with their high sediment load are significant in terms of land-derived organic carbon burial in marine sediments. (Author's abstract)
W87-02176

CHARACTERIZATION OF MICROBIAL POPULATIONS IN POLLUTED MARINE SEDIMENTS,
Dunstaffnage Marine Research Lab., Oban (Scotland).
For primary bibliographic entry see Field 5A.
W87-02217

DEVELOPMENT OF MULTIPLE SEEPAGE FACES ON LAYERED SLOPES,
British Columbia Univ., Vancouver. Dept. of Geological Sciences.
For primary bibliographic entry see Field 2F.
W87-02274

GROUND SURFACE SLOPE AS A BASIN SCALE PARAMETER,
Cornell Univ., Ithaca, NY. School of Civil and

Environmental Engineering.
For primary bibliographic entry see Field 2A.
W87-02305

MODELING ALLUVIAL CHANNELS,
For primary bibliographic entry see Field 2E.
W87-02317

SUSPENDED SEDIMENT PHOSPHORUS COMPOSITION IN TRIBUTARIES OF THE OKANAGAN LAKES, B.C.,
National Water Research Inst., Vancouver (British Columbia).
For primary bibliographic entry see Field 5B.
W87-02366

LOCALIZED CATASTROPHIC DISRUPTION OF THE GASCONADE RIVER FLOOD PLAIN DURING THE DECEMBER 1982 FLOOD, SOUTHEAST MISSOURI,
Southern Illinois Univ. at Carbondale. Dept. of Geology.
For primary bibliographic entry see Field 2E.
W87-02368

ACTIVE SAND TRANSPORT ALONG A FJORD-BOTTOM CHANNEL, BUTE INLET, BRITISH COLUMBIA,
Louisiana State Univ., Baton Rouge. Coastal Studies Inst.
D. B. Prior, B. D. Bornhold, and M. W. Johns.
Geology GLGYB, Vol. 14, No. 7, p 581-584, July 1986. 6 fig, 12 ref. NSF Grant DPP-8501118.

Descriptors: *Sand transport, *Fjords, *Channels, *Bute Inlet, *British Columbia, Basin sediments, *Sediment transport, Abyssal plains, Continental slope.

An underwater channel system is incised in the Holocene fjord basin sediments of Bute Inlet, British Columbia. High-resolution side-scan sonar swaths and seismic profiles reveal two channels within a zone of extensive rotational sliding on the slopes of a fjord-head delta. The channels coalesce into a single sinuous channel that extends 14 km downfjord on a 0.9 degree slope, where it splits into two distributaries, which continue another 18 km, ending within stacked depositional lobes. In Bute Inlet, sand is transported through a well-developed channel system on slopes of less than 1 degree, a distance of at least 35 km, to be deposited as lobate sand units in the deeper fjord basin. The geometry of the slide areas on the fjord-head delta, the source of the sediment in the channel system, indicates that an approximate volume of displaced sediment is 5.6 times 10 to the 8th power cu m. This Holocene example of large-scale, long-distance channelized sand transport appears directly analogous to some of the processes believed to have delivered sediments from continental slopes to deep-water fans and abyssal plains. (Lantz-PTT)
W87-02369

DOWNSTREAM DILUTION OF A LAHAR: TRANSITION FROM DEBRIS FLOW TO HYPERCONCENTRATED STREAMFLOW,
Cascades Volcano Observatory, Vancouver, WA.
T. C. Pierson, and K. M. Scott.
Water Resources Research WRERAQ, Vol. 21, No. 10, p 1511-1524, October 1985. 17 fig, 2 tab, 41 ref.

Descriptors: *Lahars, *Mudflows, *Volcanoes, *Streamflow, *Sediment transport, *Toutle River, *Cascade Mountains, *Mount St. Helens, Path of pollutants, Erosion, Sand, Snowmelt, Suspended load.

Nearly instantaneous melting of snow and ice by the March 19, 1982, eruption of Mount St. Helens released a 4,000,000 cu m flood of water from the crater, that was converted to a lahar (volcanic debris flow) through erosion and the incorporation of sediment, by the time it reached the base of the volcano. Over the next 81 km that it traveled down the Toutle River, the flood wave was progressively diluted through several mechanisms. A transformation from debris flow to hyperconcentrated streamflow began to occur about 27 km downstream from the crater, when the total sediment concentration had decreased to about 78% by weight (57% by volume). The hyperconcentrated lahar-runout flood wave, transporting immense quantities of sand in suspension, continued to experience progressive downstream dilution. Although turbulence was significantly dampened by the extremely high suspended load, very large standing waves and antidune waves were observed. The hyperconcentrated lahar-runout flow deposited an unusual, faintly stratified, coarse sand which locally contained small, isolated gravel lenses. Very similar deposits in the Quaternary stratigraphy of Mount St. Helens and other Cascades volcanoes suggest that lahars may be more frequent than previously recognized. (Author's abstract)
W87-02381

BIGHORN LAKE - 1982 SEDIMENTATION SURVEY,
Bureau of Reclamation, Denver, CO. Engineering and Research Center.
J. O. Blanton.
Available from the National Technical Information Service, Springfield, VA. 22161 as PB86 229481, A04 in paper copy, A01 in microfiche. Report REC-ERC-86-6, April 1986. 71 p, 85 fig, 4 tab, 3 ref.

Descriptors: *Bighorn Lake, *Sedimentation, *Lake sediments, Wyoming, Reservoir silting, Reservoir capacity, Sonar, Bathymetry, Sediment yield.

Bighorn Lake was surveyed in 1982 to compile field data needed to compute reservoir storage capacity. The data were also used to compute the volume of sediment accumulated in the reservoir since the gates in the dam were closed in 1965, and to determine the sediment distribution characteristics. Sonic depth recording equipment interfaced with an automated survey system was used to run the bathymetric survey. Reservoir capacity was computed from revised contour surface areas determined by means of a width-adjustment method for the upstream portion of the reservoir and by determining loss of contour surface area by sedimentation in the downstream portion. The reservoir capacity is 1,328,360 acre-feet and the surface area is 17,279 acres at El. 3657.0. Since November 1965, 53,950 acre-feet of sediment has accumulated, resulting in a loss in storage capacity of 3.9%. This represents an annual accumulation rate of 3,224 acre-feet or 0.314 acre-foot/sq mi. (Author's abstract)
W87-02548

ROLE OF FORESTS IN ENVIRONMENTAL PROTECTION,
For primary bibliographic entry see Field 4C.
W87-02559

2K. Chemical Processes

IDENTIFICATION OF SOLUTE LOADING SOURCES TO A SURFACE STREAM,
Geological Survey, Boston, MA. Water Resources Div.
For primary bibliographic entry see Field 5B.
W87-01891

WATER CHEMISTRY OF NORTHERN GREAT PLAINS STRIP MINE AND LIVESTOCK WATER IMPOUNDMENTS,
Forest Service, Grants Pass, OR.
M. T. Anderson, and C. L. Hawkes.
Water Resources Bulletin WARBAQ, Vol. 21, No. 3, p 499-505, June 1985. 2 fig, 2 tab, 38 ref. EPA Research grant EPA-IAG-D-5-E764.

Descriptors: *Strip mines, *Livestock, *Ponds, Northern Great Plains, North Dakota, South Dakota, Wyoming, Ions, Sodium, Calcium, Magnesium, Potassium, Chloride turbidity, Groundwater, Surface runoff, Waterfowl, Fisheries, Wetlands, Trace elements.

The water from 34 strip mine and 9 livestock water impoundments on the Northern Great Plains was analyzed. The 43 water impoundments are in North Dakota, South Dakota, and Wyoming. The study ponds range from 1.15 ha to 13 ha in area and from 2 to 67 years in age. They are shallow, having a maximum depth ranging between 1 and 12 meters. The dominant ion sequence for the study ponds was Na > Mg > K and SO4 > HCO3 > CO3 > Cl, which differs from most freshwater by the transposition of Na and SO4. Even though mean concentrations of total filterable residue were consistently greater in strip mine ponds, statially significant differences were not found between strip ponds and lifestock ponds. The macronutrients of nitrogen and phosphorus found in the ponds were neither limiting to primary productivity nor excessive for fresh water. Many ponds contain turbid water. Turbidity restricts light penetration and limits photosynthesis besides making the ponds visually unattractive. The source of water for the pond, whether surface runoff or groundwater, seems to have important bearing on turbidity. The most appropriate use of these strip mine ponds is for waterfowl, warmwater fisheries, and other wildlife associated with prairie wetlands. However, even these uses are jeopardized by detrimental concentrations of trace elements in the water and ponds should be assayed for trace element concentrations before fish are introduced. (Peters-PTT)
W87-01924

TRANSFORMATIONS OF INORGANIC PHOSPHORUS DURING THE FLOODING AND DRAINING CYCLES OF SOIL,
California Univ., Davis. Dept. of Agronomy and Range Science.
For primary bibliographic entry see Field 2G.
W87-01985

COASTAL PLAIN SOILS OF SOUTHEASTERN NIGERIA: II. FORMS OF EXTRACTABLE IRON, ALUMINUM, AND PHOSPHORUS,
Michigan State Univ., East Lansing. Dept. of Crop and Soil Sciences.
For primary bibliographic entry see Field 2G.
W87-01993

SIMULATED ACID RAIN EFFECTS ON JACK PINE SEEDLING ESTABLISHMENT AND NUTRITION,
Michigan State Univ., East Lansing. Dept. of Forestry.
For primary bibliographic entry see Field 5C.
W87-02000

EFFECT OF SOIL SUBMERGENCE ON UREA HYDROLYSIS,
International Fertilizer Development Center, Muscle Shoals, AL. Fertilizer Technology Div.
For primary bibliographic entry see Field 2G.
W87-02006

PORE GAS COMPOSITION IN WASTE ROCK DUMPS UNDERGOING PYRITIC OXIDATION,
Australian Atomic Energy Commission Research Establishment, Sutherland.
For primary bibliographic entry see Field 5B.
W87-02010

COMPUTER SIMULATIONS OF THE TRANSPORT OF PESTICIDES WITH NONUNIFORM WATER FLOW IN GREENHOUSE SOIL,
Institute for Pesticide Research, Wageningin (Netherlands).
For primary bibliographic entry see Field 5B.
W87-02011

SOIL SALINITY AS AFFECTED BY HIGH-SULFATE WATER,
Agricultural Research Inst., Nicosia (Cyprus).
For primary bibliographic entry see Field 3C.
W87-02020

DISSOLUTION OF GYPSUM IN ALKALI SOILS,
Central Soil Salinity Research Inst., Karnal (India).
For primary bibliographic entry see Field 3C.
W87-02021

FACTORS AFFECTING OXIDATION-REDUCTION PROCESSES IN AN OXISOL WITH A SEASONAL WATER TABLE,
North Carolina State Univ. at Raleigh. Dept. of Soil Science.
W. Couto, C. Sanzonowicz, and A. De. O. Barcellos.
Soil Science Society of America Journal SSSJD4, Vo. 49, No. 5, p 1245-1248, September-October 1985. 3 fig, 1 tab, 17 ref.

Descriptors: *Water table, *Oxisols, *Soil chemistry, *Cerrados, *Brazil, *Oxidation, *Reduction, Soil water, Drainage, Seasonal variation, Soil properties, Soil texture, Soil bacteria, Soil algae.

The weekly fluctuation of the water table was recorded for a period of 2 years at five sites along a transect of a high plateau area in the Cerrados of Brazil. There was minimum variation in soil color, morphology, and texture and the soil studied was a Red-Yellow Latosol. At some places the water table was within 0.4 to 2.0 m of the soil surface for more than 90 days in the year. Only a moderate range of Eh values from 700-500 mV were seen at the sites indicating that no reduction took place in the soil at any depth. Soil samples were taken from 0-80 cms depth and subjected to different treatments, and incubated for 90 days at 30 kPa water tension. Treatments consisted of nutrients, nutrients plus lime, and sucrose. Intensive reduction took place in all soil samples taken from 0-40 cms depth. Samples taken below 40 cms indicated that reduction did not occur in the lower part of the soil profile even when a high water table is present due to the lack of a source of energy for microbial activity. The organic matter in the lower part of the soil profile was too stable and/or too low in nutrients for the reduction process to take place during the water logging period. (Khumbatta-PTI)
W87-02038

ACIDITY OF SCOTTISH RAINFALL INFLUENCED BY CLIMATIC CHANGE,
University of East Anglia, Norwich (England). Climatic Research Unit.
For primary bibliographic entry see Field 5B.
W87-02078

DETERMINATION OF ALKYLLEAD SALTS IN RUNOFF, SOILS, AND STREET DUSTS CONTAINING HIGH LEVELS OF LEAD,
Macdonald Coll., Ste. Anne de Bellevue (Quebec). Dept. of Food Science and Agricultural Chemistry.
For primary bibliographic entry see Field 5B.
W87-02090

COMPARISON OF FOUR CHROMOGENIC REAGENTS FOR THE FLOW-INJECTION DETERMINATION OF ALUMINIUM IN WATER,
Norsk Inst. for Skogforskning, Aas. Div. of Forest Ecology.
For primary bibliographic entry see Field 5A.
W87-02165

DETERMINATION OF TRACE METALS IN LOW IONIC STRENGTH WATERS USING ZEEMAN AND DEUTERIUM BACKGROUND CORRECTION FOR GRAPHITE FURNACE ATOMIC ABSORPTION SPECTROMETRY,
Geological Survey, Arvada, CO.
For primary bibliographic entry see Field 5A.
W87-02236

MODELING THE RATE-CONTROLLED SORPTION OF HEXAVALENT CHROMIUM,
Geological Survey, Denver, CO.
For primary bibliographic entry see Field 5B.
W87-02283

MIXING EFFECTS OF CARBONATE DISSOLVING WATERS ON CHEMICAL AND 13-C/12-C COMPOSITIONS,
Marie Curie-Sklodowska Univ., Lublin (Poland). Inst. of Physics.
P. Staniaszek, and S. Halas.
Nordic Hydrology, Vol. 17, No. 2, p 93-114, 1986. 9 fig, 3 tab, 35 ref.

Descriptors: *Mixing, *Carbonates, *Chemical analysis, *Carbon, Inorganic compounds, Lublic, Poland, Aquifers, Seasonal variation, Carbon dioxide, Hydrogen ion concentration, Carbon isotopes.

Seasonal variations in chemistry, and 13-C/12-C ratios of total inorganic carbon in carbonate dissolving waters are considered in the framework of a simplified approach dealing explicitly with major ionic species. Unidirectional evolution models are supplemented by taking mixing effects into consideration. These effects, caused mainly by the redistribution of carbon-bearing species in the mixture, are to a great extent nonlinear and unsymmetric with respect to the fraction of the second solution in a binary mixture. The theoretical considerations are supported by observations of many samples taken during a period from January to May 1977 in SW Lublin, Poland. The parameters PCO2 and delta 13-C of a reservoir lose their primary meaning in the case of mixing of waters, but investigation of their changes may help in studying some conditions in the soil. During the period of observation (except March) the estimated values of PCO2 of a reservoir tended to lie in a narrow range of values from 10 to the -1.3 to 10 to the -1.4 atm. In March those values were higher due to the large inflow of CO2-rich waters into the aquifer. The estimated delta 13-C values of a reservoir CO2 spread from -17 to -27 permil during January to March. In April and May those values focused in a narrow range from -22 to -26 permil. This tendency indicates that waters inflowing in March and April transported isotopically lighter CO2. Both HCO3(-) content and delta 13-C of total carbon versus pH allowed to search inflows of infiltrating water into particular areas of the aquifer. It has been shown that delta 13-C investigations are necessary to notice the admixing of waters in certain cases. (Author's abstract)
W87-02329

DETERMINATION OF TOTAL PHOSPHORUS IN SEAWATER BY NITRATE OXIDATION OF THE ORGANIC COMPONENT,
British Columbia Univ., Vancouver.
For primary bibliographic entry see Field 5A.
W87-02367

GEOCHEMISTRY OF GROUNDWATER IN CRETACEOUS SEDIMENTS OF THE SOUTHEASTERN COASTAL PLAIN OF EASTERN MISSISSIPPI AND WESTERN ALABAMA,
Geological Survey, Atlanta, GA.
R. W. Lee.
Water Resources Research WRERAQ, Vol. 21, No. 10, p 1545-1556, October 1985. 9 fig, 8 tab, 22 ref.

Descriptors: *Geochemistry, *Cretaceous sediments, *Mississippi, *Alabama, Groundwater movement, Aquifers, Dissolved solids, Hydrogen ion concentration, Sodium, Bicarbonate, Carbon, Oxidation, Carbon radioisotopes, Brines, Coker Aquifer, Ripley Aquifer, Calcite.

Geochemical samples of waters along two hydrologic flow paths in four Upper Cretaceous aquifers of northeastern Mississippi and western Alabama, indicate similar geochemical evolution of their respective waters. The waters of the Coker, Gordo and Eutaw-McShan aquifers, noncalcareous sands, increase downgradient in dissolved solids and pH, and are dominated by sodium and bicarbonate ions, which generally result from a calcite dissolution-cation exchange process. Increases in dissolved iron from oxidation reduction reactions, followed by decreases in total inorganic carbon from siderite precipitation, occur along the flow paths. As the total inorganic carbon increases, carbon-13 generally is enriched in the moving waters, indicating the addition of a predominantly heavy source of carbon, most likely dissolving calcite. In the Coke aquifer carbon-13 values in the waters become more negative downgradient, resulting from lignite oxidation, followed by carbon-13 values becoming more positive, resulting from dissolving calcite and perhaps some mixing with brines. In northeastern Mississippi, the Ripley aquifer, a calcareous sand, initially contains calcium-bicarbonate dominated water that evolves to a sodium-bicarbonate dominated water downgradient, primarily from the calcite dissolution-cation exchange process. Feldspar hydrolysis to kaolinite dominates aluminosilicate reactions in the upgradient parts of the aquifers. Authigenesis of smectite clay may be occurring in the deeper, downgradient parts of the aquifers. (Author's abstract)
W87-02384

HEAVY METAL BINDING TO DIGESTED SLUDGE,
Birmingham Univ. (England). Dept. of Civil Engineering.
For primary bibliographic entry see Field 5D.
W87-02392

SIMULTANEOUS DETERMINATION OF TOTAL ORGANIC CARBON AND TOTAL NITROGEN IN WATERS BY PYROLYSIS-GAS CHROMATOGRAPHY-MASS SPECTROMETRY,
Government Industrial Research Inst., Nagoya (Japan).
For primary bibliographic entry see Field 5A.
W87-02417

PRECONCENTRATION OF COPPER IN WATER SAMPLES WITH 2-MERCAPTOBENZOTHIAZOLE ON NAPHTHALENE,
Fukui Univ. (Japan). Faculty of Engineering.
For primary bibliographic entry see Field 5A.
W87-02421

PARAUARI - MAUES - ACU RIVER BASIN. CHEMICAL CHARACTERISTICS CAUSED BY HYDROLOGIC CHANGES IN THE BASIN, (BACIA DO RIO PARAUARI - MAUES - ACU: ASPECTOS QUIMICOS AS ALTERACOES HIDROLOGICAS DA BACIA),
Instituto Nacional de Pesquisas da Amazonia, Manaus (Brazil).
S. R. B. Bringel, U. de M. Santos, M. de N. G. Ribeiro, and H. Bergamin.
Acta Amazonica, Vol. 14, No. 1/2, p 77-85, March-June 1984. 1 fig, 1 tab, 8 ref.

Descriptors: *Parauari River, *Metals, *River systems, *Cations, *Anions, *Hydrogen ion concentration, Hydrographs, Magnesium, Sodium, Potassium, Calcium, Iron, Chlorides, Solute transport, Copper, Zinc, Manganese, Seasonal variation.

The chemical characteristics of the Parauari - Maues - Acu River Basin were examined. Water samples were collected during four different excursions at eleven points along the mainstream and tributaries. Samples were analyzed for pH, and for concentrations of magnesium, sodium, potassium, calcium, iron, chloride, copper, zinc, and manganese. Highest pH values were recorded at the times of lowest water level. The variations in metal concentrations are individually discussed. The results demonstrate a clear seasonal fluctuation in the Parauari - Maues - Acu and some of its principal tributaries. These fluctuations are directly related to variations in the river hydrograph showing the importance of this water mass in the movement of solutes along the basin. (Author's abstract)
W87-02429

RIVERS OF THE AMAZON BASIN. I. TRIBUTARIES OF THE RIO NEGRO, (RIOS DA BACIA AMAZONICA. I. AFLUENTES DO RIO NEGRO),
Instituto Nacional de Pesquisas da Amazonia, Manaus (Brazil).
For primary bibliographic entry see Field 5B.
W87-02431

EXPERIENCES WITH ICP MASS SPECTROMETRY IN WATER ANALYSIS, (ERFAHRUNGEN MIT DER ICP MASSENSPEKTROMETRIE IN DER WASSERANALYTIK),
Ruhrverband, Essen (Germany, F.R.). Chemisches und Biologisches Lab.
For primary bibliographic entry see Field 5A.
W87-02432

DETERMINATION OF ORGANIC HETEROATOMS IN WATERS, (ZUR BESTIMMUNG ORGANISCH GEBUNDENER HETEROATOME IN GEWAESSERN),
Technische Univ. Muenchen (Germany, F.R.). Inst. fuer Wasserchemie und Chemische Balneologie.
F. H. Frimmel.
Fresenius' Zeitschrift fuer Analytische Chemie ZACFAU, Vol. 324, p 223-224, June 1986. 1 tab, 7 ref.

Descriptors: *Water analysis, *Chemical analysis, Nitrogen compounds, Sulfur compounds, Phosphorus compounds, Mercury, Tin, Halogens, Metals.

The procedures commonly used to determine the content in water samples of the following heteroatoms: nitrogen, sulfur, phosphorus, halogens, mercury, and tin are surveyed. A reference is given in each case for more detailed information. Some general background on the determination of these substances in water samples is included. (Airone-PTT)
W87-02433

TRACE DETERMINATION OF MOLYBDENUM AND VANADIUM IN NATURAL WATERS BY MEANS OF ATOMIC SPECTROSCOPY (AAS, ICP-OES) AFTER PRECONCENTRATION,
Institut fuer Spektrochemie und Angewandte Spektroskopie, Dortmund (Germany, F.R.).
P. Burba, and P. G. Willmer.
Fresenius' Zeitschrift fuer Analytische Chemie ZACFAU, Vol. 324, p 298-299, June 1986. 1 fig, 1 tab, 8 ref.

Descriptors: *Water analysis, *Molybdenum, *Chemical analysis, *Vanadium, *Atomic absorption spectroscopy, Trace metals, Surface water, Mineral water.

The accurate and precise determination of Mo and V in natural waters by means of AAS and ICP-OES often requires a separation and/or a preconcentration step. For the reliable and simple separation of Mo and V in the nanogram/liter to microgram/liter range, coprecipitation on Cell-Fe and Cell-In can be applied with good reproducibility. By coupling with atomic spectroscopy, this analytical procedure provides ultratrace determination of Mo and V, even in complex water matrices or biological fluids (e.g. urine). A study of surface water samples using this procedure resulted in determination in the 0.3- to 1-microgram/liter range. (Airone-PTT)
W87-02436

HYDROGEOCHEMISTRY OF RADON IN GROUND WATER,
Maine Geological Survey, Augusta.
E. M. Lanctot, A. L. Tolman, and M. Loiselle.
IN: The Second Annual Eastern Regional Ground Water Conference, July 16-18, 1985, Portland, Maine. 1985. p 66-85, 4 fig, 3 tab, 18 ref.

Descriptors: *Geohydrology, *Geochemistry, *Radon, *Groundwater pollution, Water pollution sources, Groundwater movement, Uranium, Aquifers, Flow pattern, Erosion, Fracture permeability, Geologic fractures, Maine, Mapping.

During the past several years, a number of investigators have worked toward a correlation of radon concentrations in groundwater with geologic terrains. While good general predictors have been developed, there is a wide variability of observed radon in groundwater in any one rock type. Additional data, collected as part of an epidemiological pilot study, has helped to clarify some variables in the equation. Radon concentrations are a function of both the aquifer hydraulics and uranium geochemistry within the aquifer. The well's position within the flow system, particularly depth and length of flow path, is an important variable. Another controlling variable is the proximity to pegmatitic and other late-stage differentiates. Together, those account for most of the observed variation in radon concentrations. This phenomenon can be understood using the physics of fracture rock flow and the geochemistry of uranium deposition. Late-stage magmatic differentates, often pegmatitic, are enriched in uranium. These pegmatitic bodies also tend to be resistant to erosion and carry fractures well. Water is therefore channelled through these recharge areas, and pick up radon as it is generated by uranium decay. Longer groundwater flow paths result in higher radon levels since the water is exposed to more radon-emitting rock. An example in mid-coastal Maine shows radon's variability. Concentrations range from a few thousand to 800,000 picocuries per liter (pCi/L) in adjacent residential wells. With adequate geologic and hydrogeologic mapping, areas of high groundwater radon can be predicted and avoided. (See also W87-02437) (Author's abstract)
W87-02442

EVALUATING CADMIUM SOLUBILITY IN A LANDFILL WITH MINERAL STABILITY ANALYSES,
Goldberg-Zoino and Associates, Inc., Newton Upper Falls, MA.
For primary bibliographic entry see Field 5B.
W87-02515

BIOSPHERE, LANDSCAPE AND NATURAL RESOURCES,
University of Agriculture, Godollo (Hungary). Dept. of Botany and Plant Physiology.
For primary bibliographic entry see Field 5B.
W87-02554

ROLE AND IMPORTANCE OF ECOSYSTEMS IN THE BIOSPHERE,
University of Agriculture, Godollo (Hungary). Dept. of Botany and Plant Physiology.
M. Kovacs.
IN: Pollution Control and Conservation, Ellis Horwood Ltd., Chichester, England, 1985. p 37-66, 11 fig, 1 tab, 48 ref.

Descriptors: *Biosphere, *Ecosystems, Ecological distribution, Natural resources, Bioindicators, Environmental quality, Primary productivity, Secondary productivity, Cycling nutrients, Carbon, Nitrogen, Phosphorus.

The ecosystem can be a small or large part of the biosphere. It is the joint functioning and dynamic unit of the biotope (inanimate environment) and biocoenosis (plant and animal kingdom) and has a definite material and energy flow. The main sources of oxygen, the environmental factors, their role in biogeochemical cycles, the so-called loadability of ecological factors, the productivity of ecosystems and factors determining production must equally be analyzed. Changes in the environmental factors should be measured continuously, with special respect to the degree of accuracy of man-made measures or their expected effects. In order to gain appropriate scientific information, it is necessary to carry out a thorough study of the main basic ecosystems (seas, fresh waters, forests, marshes, meadows, etc.) of the Earth, to make vegetation and soil maps, to determine the basic rules and to establish the probable interaction between man and his environment. This chapter explains this by discussing: the components of the ecosystem; environmental factors and bioindicators; primary and secondary production; food chains, trophic levels, food pyramid and energy flow; bio-geochemical and nutrient cycles; and changes in the food cycle brought about by anthropogenic impacts. (See Also W87-02553) (Lantz-PTT)
W87-02555

2L. Estuaries

ATTACHED AND FREE-FLOATING BACTERIOPLANKTON IN HOWE SOUND, BRITISH COLUMBIA, A COASTAL MARINE FJORD-EMBAYMENT,
Simon Fraser Univ., Burnaby (British Columbia). Dept. of Biological Sciences.
L. J. Albright, S. K. McCrae, and B. E. May.
Applied and Environmental Microbiology AEMIDF, Vol. 51, No. 3, p 614-621, March 1986. 8 fig, 26 ref.

Descriptors: *Bacteria, *Plankton, *Howe Sound, *British Columbia, *Fjord, *Canada, *Attachment, *Nutrition, Ecology, Chrysophyta, Bacillariophyta, Silt, Salinity, Chlorophyll a, Bacterial physiology, Growth, Senescent phytoplankton populations.

Factors that influence the attachment of bacterioplankton to particles (including phytoplankton) were investigated by using (1) water samples removed from Howe Sound over an annual cycle and (2) unialgal cultures of Prorocentrum minimum, Dunaliella tertiolecta, and Skeletonema costatum. Silt and salinity levels in this fjord seawater did not appear to influence bacterial attachment, but the percent attached bacteria was inversely related to both chlorophyll a concentrations and primary productivities. During periods of high primary productivities, the percent attached bacteria was low, whereas during periods of low, increasing, or declining primary productivities, the percent attached bacteria was high. A similar pattern of bacterial attachment was observed when the three phytoplankton were grown as batch cultures. The percent attached bacterial numbers increased upon the initiation of algal growth and after these cells stopped growing, but not while the algae were growing. The authors suggest that a major factor influencing the attachment of bacterioplankton is the physiological condition of their major nutrient source, the phytoplankton; mainly free-living bacteria are associated with growing phytoplankton, whereas a much greater proportion of the bacteria are attached among senescent phytoplankton populations. (Author's abstract)
W87-01787

PHYTOPLANKTON RESPONSE TO FRESHWATER RUNOFF: THE DIVERSION OF THE EASTMAIN RIVER, JAMES BAY,
McGill Univ., Montreal (Quebec). Inst. of Oceanography.
For primary bibliographic entry see Field 5C.
W87-01794

STOCHASTIC POPULATION MODEL FOR MANAGING THE ATLANTIC MENHADEN (BREVOORTIA TYRANNUS) FISHERY AND ASSESSING MANAGERIAL RISKS,
North Carolina Univ. at Chapel Hill. Dept. of Statistics.
For primary bibliographic entry see Field 8I.
W87-01801

ORGANIC MATTER IN THE GULF OF ST. LAWRENCE IN WINTER,
Bedford Inst. of Oceanography, Dartmouth (Nova Scotia).
R. Pocklington.
Canadian Journal of Fisheries and Aquatic Sciences CJFSBX, Vol. 42, No. 9, p 1556-1561, September 1985. 3 fig, 7 tab, 16 ref.

Descriptors: *Particulate organic nitrogen, *Particulate organic carbon, *Organic matter, *Dissolved organic carbon, *Gulf of Saint Lawrence, Canada, *Seasonal variation, Estuaries, Cabot Strait.

Eighteen oceanographic stations in the Gulf of St. Lawrence (Canada) were occupied in 1984, and water samples taken by Niskin bottle were obtained from depths from the surface to 450 m. Concentrations of organic matter (particulate organic N, particulate organic C, dissolved organic

C) were low in the Gulf of St. Lawrence in winter, comparable to levels in waters outside the Gulf. There was no substantial export of organic matter from the Gulf through Cabot Strait at this time. Within the Gulf, particulate transports into and out of the estuary were lower than at other seasons. (Rochester-PTT)
W87-01809

POTENTIAL USEFULNESS OF CHLORINE FOR CONTROLLING PACIFIC SALMON LEECHES, PISCICOLA SALMOSITICA, IN HATCHERIES,
Department of Fisheries and Oceans, Nanaimo (British Columbia). Fisheries Research Branch.
For primary bibliographic entry see Field 8I.
W87-01816

COMPARATIVE ANALYSIS OF IONOREGULATION IN RAINBOW TROUT (SALMON GAIRDNERI) OF DIFFERENT SIZES FOLLOWING RAPID AND SLOW SALINITY ADAPTATION,
Prince Edward Island Univ., Charlottetown. Dept. of Biology.
For primary bibliographic entry see Field 8I.
W87-01817

FUNDY TIDAL POWER DEVELOPMENT AND POTENTIAL FISH PRODUCTION IN THE GULF OF MAINE,
Maine State Dept. of Marine Resources, West Boothbay Harbor.
For primary bibliographic entry see Field 4A.
W87-01822

OPTIMAL STOCK SIZE AND HARVEST RATE IN MULTISTAGE LIFE HISTORY MODELS,
British Columbia Univ., Vancouver. Inst. of Animal Resource Ecology.
For primary bibliographic entry see Field 8I.
W87-01825

MODIFICATION OF BIOACCUMULATION OF SELENIUM BY MYTILUS EDULIS IN THE PRESENCE OF ORGANIC AND INORGANIC MERCURY, (MODIFICATION DE LA BIOACCUMULATION DU SELENIUM CHEZ MYTILUS EDULIS EN PRESENCE DU MERCURE ORGANIQUE ET INORGANIQUE),
Institut National de la Recherche Scientifique, Rimouski (Quebec).
For primary bibliographic entry see Field 5C.
W87-01827

CONTINUOUS SOURCE OF TIDAL FLOW: A NUMERICAL STUDY OF THE TRANSPORT EQUATION,
Hong Kong Univ. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5B.
W87-01834

WINTER SURVIVAL AND GROWTH OF CHONDRUS CRISPUS IN ONSHORE CULTURE TANKS,
National Research Council of Canada, Halifax (Nova Scotia). Atlantic Regional Lab.
P. F. Shacklock, and J. S. Craigie.
Canadian Journal of Fisheries and Aquatic Sciences CJFSBX, Vol. 43, No. 2, p 263-268, February 1986. 1 fig, 3 tab, 21 ref.

Descriptors: *Chondrus crispus, *Aquaculture, *Seawater, *Winter survival, *Plant growth, Density, Plant physiology, Culture tanks.

Two procedures were tested for ensuring the winter survival of a healthy vegetative inoculum of Chondrus crispus for commerical aquaculture. Agitated cultures of C crispus (stocking density <6 kg/sq m) in running seawater grew at average rates of 0.21-0.34 kg/sq m per wk during two winters under natural irradiance. Cultures maintained in undisturbed, outdoor tanks of seawater over three winters showed little or no net production, but survival was excellent provided the stocking density remained below approximately 10 kg/sq m. The plants were capable of resuming growth when environmental conditions improved. No difference was observed in the responses of the several haploid and diploid isolates examined. Large vegetative inocula required for commercial aquaculture can be maintained simply and reliably in tanks of clean seawater if they are undisturbed and an ice cover is allowed to form. (Author's abstract)
W87-01845

NUTRIENT STATUS OF PHYTOPLANKTON BLOOMS IN NORWEGIAN WATERS AND ALGAL STRATEGIES FOR NUTRIENT COMPETITION,
Trondheim Univ. (Norway). Biological Station.
For primary bibliographic entry see Field 2H.
W87-01853

NUTRIENT ENRICHMENT STUDIES IN A COASTAL PLAIN ESTUARY: PHYTOPLANKTON GROWTH IN LARGE-SCALE, CONTINUOUS CULTURES,
Maryland Univ., Solomons. Chesapeake Biological Lab.
For primary bibliographic entry see Field 5A.
W87-01854

REVERSIBLE ADSORPTION OF AQUEOUS DIVALENT COPPER ION BY ESTUARINE SEDIMENTS,
Auburn Univ., AL. Dept. of Chemistry.
J. E. Teggins, and D. J. Slinn.
Water Resources Bulletin WARBAQ, Vol. 21, No. 3, p 465-468, June 1985. 2 fig, 4 tab, 10 ref.

Descriptors: *Path of pollutants, *Fate of pollutants, *Heavy metals, *Sediments, *Copper, *Rivers, Mining, Isle of Man, Zinc, Lead, Iron, Leaching, Mollusks.

Sediments were equilibrated with solutions containing divalent copper ion. A colorimetric method using the triethylenetetramine complex of the metal ion was employed to measure changes in uptake of copper by the sediments. Studies were made with sediments from rivers in the British Isles which were in the proximity of areas which had been mined for metals for several hundred years. For comparison, similar studies were performed with a sample of sand and a soil with a high organic content. It was possible to follow the uptake of copper ion by the materials and estimate their abilities to adsorb copper ion. In particular, a strong correlation was observed between the organic content of the sediment and the total amount of copper adsorbed by the sample. It was possible to demonstrate that the adsorption of the metal ion was reversible. The Isle of Man, where the work was carried out, has a history of mining (principally for zinc, lead, copper, and some iron) which ceased earlier in the twentieth century. Nevertheless, metals continue to be leached from the remains of spoil heaps, and the sediments and bivalve mollusks of two estuarine harbors (Peel and Laxey) associated with rivers flowing through the principle mining areas contain enhanced levels of these metals. All of the sediments adsorbed copper ion from aqueous solution. Variation of sediment to copper ion ratios suggested that an equilibrium situation existed between free metal ion in solution and metal ion bound to the sediment after the initial reaction has ceased. The amount of copper ion adsorbed by each deposit was related to its organic carbon content. The inner harbor samples each adsorbed more copper ion than their outer harbor counterparts. That the sediments could be regarded as inefficient ion exchange materials for copper from sediments suggests that in these sediments copper is in a relatively labile form. (Peters-PTT)
W87-01919

BIOMASS ASSESSMENT OF ESTUARINE MACROPHYTOBENTHOS USING AERIAL PHOTOGRAPHY,
Rijkswaterstaat, The Hague (Netherlands).
C. Meulstee, P. H. Nienhuis, and H. T. C. Van Stokkom.
Marine Biology MBIOAJ, Vol. 91, No. 3, p 331-335, June 1986. 2 fig, 1 tab, 14 ref.

Descriptors: *Biomass, *Estuarine environment, *Macrophytes, *Benthos, *Aerial photography, Mud flats, Photography, Benthic environment, Flora, Aquatic plants, Benthic flora, Intertidal areas.

Traditional approaches for biomass assessment of estuarine macrophytes over vast areas are time consuming. A methodology for quick and accurate biomass estimation of macrophytes growing in intertidal mudflats has been developed and verified. Using a calculated relation between biomass and color densities on the aerial photographs, biomass of macrophytes over a large area (ca 900 ha) could be assessed with an accuracy of about 10%. Biomass estimates could be partitioned over seagrasses, various green algae, and brown algae. (Author's abstract)
W87-01940

INTERTIDAL MICROALGAL PRODUCTION AND THE AUXILIARY ENERGY OF TIDES,
Laval Univ., Quebec. Dept. de Biologie.
I. Lamontagne, A. Cardinal, and L. Fortier.
Marine Biology MBIOAJ, Vol. 91, No. 3, p 409-419, June 1986. 9 fig, 3 tab, 42 ref.

Descriptors: *Intertidal areas, *Microflora, *Algae, *Energy, *Tides, *Estuarine environment, Environment, Photosynthesis, Water level, Light intensity, Fragilaria, Diatoms.

The photosynthetic response of an estuarine epilithic microflora exposed to natural variations in water level and light intensity was monitored. Fragilaria striatula dominated the assemblage. During spring tide, wave induced turbulence at low tide eroded the arborescent stratum of the cell mat. The physiological condition of the remaining prostrate stratum was poor. The photosynthetic response of the community was weak and showed little variability. During neap tide, the arborescent stratum of the permanently inundated community persisted. The community showed a stronger and more variable photosynthetic response. During this period, fluctuations in the magnitude of the Photosynthesis-Irradiance curve and maximum photosynthetic rate were dominated by a 24-h periodicity, but also presented a secondary semidiurnal rhythm. The circadian periodicity in the photosynthetic response may be explained by postulating an endogenous control. Circatidal variations in maximum photosynthetic rate may have been related to tidal fluctuations in nutrient availability. The fortnightly renewal of space by the auxiliary energies of wind and tides apparently controlled the dynamics of the community. (Author's abstract)
W87-01941

UPTAKE AND DEPURATION OF ORGANIC CONTAMINANTS BY BLUE MUSSELS (MYTILUS EDULIS) EXPOSED TO ENVIRONMENTALLY CONTAMINATED SEDIMENT,
Rhode Island Univ., Narragansett. Graduate School of Oceanography.
For primary bibliographic entry see Field 5B.
W87-01942

LONG-TERM CHANGES IN THE BENTHIC COMMUNITY ON THE COASTAL SHELF OF PALOS VERDES, SOUTHERN CALIFORNIA,
Los Angeles County Sanitation Districts, Whittier, CA.
J. K. Stull, C. I. Haydock, R. W. Smith, and D. E. Montagne.
Marine Biology MBIOAJ, Vol. 91, No. 4, p 539-551, June 1986. 9 fig, 2 tab, 44 ref.

Descriptors: *Water pollution effects, *Benthos, *Coastal waters, *Palos Verdes, California, *Succession, *Ecology, Benthic fauna, Spatial distribution, Temporal distribution, Aquatic life, Wastewater disposal, Distribution, Water quality.

Between 1972 and 1982, both wastewater discharge and natural perturbations played important

roles in directing marine benthic community structure on the Palos Verdes Shelf in Southern California. Community succession was traced along a gradient of eleven 60 m-depth stations extending from the submarine outfalls. Spatial and temporal biological patterns were identified via direct gradient, clustering, and principal-coordinates analyses. Species associations which occupied sites distant from the outfalls in the early 1970s gradually became established closer to the diffusers during the decade. The spatial extent of outfall impacts decreased, reflecting both improvements in effluent quality and co-occurring beneficial natural events, specifically the short-term settlement of large numbers of the echiuran Listriolobus pelodes. (Author's abstract)
W87-01943

MYTILUS EDULIS PLANULATUS: AN 'INTEGRATOR' OF CADMIUM POLLUTION,
Victoria Ministry for Conservation, Queenscliff (Australia). Marine Science Labs.
For primary bibliographic entry see Field 5B.
W87-01944

CONTRIBUTION TO THE ECOTOXICOLOGICAL STUDY OF CADMIUM, COPPER AND ZINC IN THE MUSSEL MYTILUS EDULIS: II. EXPERIMENTAL STUDY,
Nantes Univ. (France). Centre de Dosage des Elements Traces.
For primary bibliographic entry see Field 5B.
W87-01945

UPTAKE AND CLEARANCE OF DIESEL ALKANES FROM SEDIMENTS BY THE GREAT BARRIER REEF GASTROPOD STROMBUS LUHUANUS,
Griffith Univ., Nathan (Australia). School of Australian Environmental Studies.
For primary bibliographic entry see Field 5B.
W87-01946

SEASONAL COMPOSITION OF MEROPLANKTON AND HOLOPLANKTON IN THE BRISTOL CHANNEL,
Institute for Marine Environmental Research, Plymouth (England).
R. Williams, and N. R. Collins.
Marine Biology MBIOAJ, Vol. 92, No. 1, p 93-101, July 1986. 7 fig, 1 tab, 25 ref. Dept. of the Environment (England) Contract DGR/480/48.

Descriptors: *Seasonal distribution, *Species composition, *Plankton, *Bristol Channel, *Estuarine environment, Zooplankton, Biomass, Phytoplankton, Primary productivity, Productivity, Benthos.

A decreasing gradation in the plankton standing stock of the Bristol Channel was observed from the seaward section to the inner, less saline, reaches. Two sub-regions, the North Outer Channel (NOC) and the Inner Channel (IC), represented extremes of the gradient and were studied in detail. The omnivorous plankton accounted for 76% of the standing stock in the NOC and 89% in the IC, of which 58% and 23% were meroplankton, and 39% and 71% were holoplankton, respectively. In the NOC and IC, carnivorous plankton accounted for 24% and 11% of the total plankton biomass, respectively. Of these, 20% and 21% were meroplanktonic, and 75% and 74% were holoplanktonic, respectively. Zooplankton biomass reached a maximum in July. Low primary production estimates for the IC lead to the conclusion that most of the chlorophyll, like the total particulate carbon, was allochthonous in origin. It also is suggested that zooplankton plays a minor role in this estuarine ecosystem and is not the main consumer of the suspended particulate carbon, a role presumably filled there by benthic filter-feeders. (Doria-PTT)
W87-01948

BIOGEOCHEMICAL CYCLING OF LIGNOCELLULOSIC CARBON IN MARINE AND FRESHWATER ECOSYSTEMS: RELATIVE CONTRIBUTIONS OF PROCARYOTES AND EUCARYOTES,
Georgia Univ., Athens. Dept. of Microbiology.
For primary bibliographic entry see Field 2H.
W87-01975

DISSOLVED HYDROCARBON METABOLISM: THE CONCENTRATION-DEPENDENT KINETICS OF TOLUENE OXIDATION IN SOME NORTH AMERICAN ESTUARIES,
Alaska Univ., Fairbanks. Inst. of Marine Science.
D. K. Button, and B. R. Robertson.
Limnology and Oceanography LIOCAH, Vol. 31, No. 1, 101-111, January 1986. 8 fig, 3 tab, 19 ref. EPA Grant 808178-01.

Descriptors: *Marine bacteria, *Biodegradation, *Fate of pollutants, *Toluene, *Metabolism, *Oxidation, *Estuaries, *Kinetics, *Self-purification, Seawater, Alaska, Texas, Resurrection Bay, Port Valdez, Lydia Ann Channel, Port Aransas, Turnover times, Hydrocarbons.

The metabolism of toluene by natural populations of marine bacteria, obtained from Resurrection Bay and Port Valdez, Alaska, and Lydia Ann Channel near Port Aransas, Texas, and stored to enhance their activity, gave hyperbolic kinetics with saturation at only K sub t = 0.6 to 3.4 microgram/liter (ug/l). Similarly, K sub t in fresh seawater was 0.26 ug/l toluene. Freshly collected populations could be moderately active toward toluene, affinity a squared sub A = 1.1-37.5 liters/g cells per hr. These moderate affinities, taken together with the small K sub t values, give an explanation for the failure of most marine bacteria to grow at the expense of a single hydrocarbon. In two experiments there was a significant first-order region in toluene in the 10-50 ug/l range. When cultures of Pseudomonas sp strain T2 were cast in suspended agar blocks to impede diffusion, toluene oxidation still followed hyperbolic kinetics although CO2 production and organic product formation were characterized by larger Michaelis constants. A large widespread population of bacteria with inducible capacity to metabolize hydrocarbons is indicated. Observed turnover times for toluene were 0.2-40 yr, with growth rates of .000001 per hr from toluene at 1 ug/l. (Author's abstract)
W87-01976

MECHANISTIC, NUMERICAL MODEL OF SEDIMENTATION, MINERALIZATION, AND DECOMPOSITION FOR MARSH SEDIMENTS,
South Carolina Univ., Columbia. Dept. of Biology.
J. T. Morris, and W. B. Bowden.
Soil Science Society of America Journal SSSJD4, Vol. 50, No. 1, p 96-105, January-February 1986. 7 fig, 3 tab, 50 ref. NSF Grant DEB 81-12090.

Descriptors: *Sedimentation, *Mineralization, *Decomposition, *Tidal marshes, *Sediments, *Computer models, *Numerical models, *Nutrients, *Organic matter, North River, Massachusetts, Nitrogen, Phosphorus, Nutrient budgets, Productivity, Carbon, Diagenesis.

A computer model is described that relates measured nutrient profiles to organic matter diagenesis in marsh sediments and includes sedimentation of exogenous and endogenous organic and inorganic matter, decomposition, above- and below-ground biomass and production, and N and P mineralization. Sediment inputs were specified for a freshwater, tidal marsh on the North River, Massachusetts, and the model was solved for nutrient mineralization rates by fitting the model to observed nutrient profiles. Model calculations of net annual N and P export from a 1-m sediment column, 9.6-17.5 g N/sq m per yr and 1.19-2.02 g P/sq m per yr, were sensitive to small changes in estimates of below-ground production and the fraction of organic matter that is refractory. The model demonstrated that mature marshes with deep sediments recycle proportionally more of the nutrients required by primary producers than young marshes with shallow sediments. Model calculations indicated that the greatest changes in C, N, and P occur in the upper 2 cm of sediment. The model is sufficiently general to be useful in studies of sediment formation and nutrient cycling in other systems. (Author's abstract)
W87-01989

SIMULTANEOUS OUTFLOW OF FRESH WATER AND INFLOW OF SEA WATER IN A COASTAL SPRING,
Montpellier-2 Univ. (France). Lab. d'Hydrogeologie.
For primary bibliographic entry see Field 2F.
W87-02079

POTENTIAL FOR EVOLUTION OF SALT (NACL) TOLERANCE IN SEVEN GRASS SPECIES,
Liverpool Univ. (England). Dept. of Botany.
For primary bibliographic entry see Field 2I.
W87-02080

FATE OF AMMONIUM IN A GULF COAST ESTUARINE SEDIMENT,
Louisiana State Univ., Baton Rouge.
For primary bibliographic entry see Field 5B.
W87-02095

ESTABLISHMENT OF A SPARTINA ANGLICA POPULATION ON A TIDAL MUDFLAT: A FIELD EXPERIMENT,
Delta Inst. for Hydrobiological Research, Yerseke (Netherlands).
For primary bibliographic entry see Field 2I.
W87-02115

RESONANT SLOSHING IN SHALLOW WATER,
Oxford Univ. (England). Mathematical Inst.
For primary bibliographic entry see Field 8B.
W87-02130

RELATIVE SALT TOLERANCE OF CAKILE EDENTULA (BRASSICACEAE) FROM LACUSTRINE AND MARINE BEACHES,
California Univ., Davis. Dept. of Botany.
For primary bibliographic entry see Field 2I.
W87-02182

GRAVITY CURRENTS IN ROTATING SYSTEMS,
Australian National Univ., Canberra. Research School of Earth Sciences.
For primary bibliographic entry see Field 2E.
W87-02224

WIND-WAVE PREDICTION,
California Univ., Berkeley. Dept. of Civil Engineering.
For primary bibliographic entry see Field 8B.
W87-02225

RELATIONSHIP BETWEEN NUTRIENTS, DOMINANT IONS, AND PHYTOPLANKTON STANDING CROP IN PRAIRIE SALINE LAKES,
Alberta Univ., Edmonton. Dept. of Zoology.
For primary bibliographic entry see Field 2H.
W87-02246

SEASONAL AND AREAL DIFFERENCES IN THE THYROID HISTOLOGY OF THE VENDACE (COREGONUS ALBULA L.) IN FRESH AND BRACKISH WATERS IN FINLAND,
Kuopio Univ. (Finland). Dept. of Applied Zoology.
For primary bibliographic entry see Field 5C.
W87-02333

ECOLOGY OF IPHIGENIA TRUNCATA IN LAGOS LAGOON,
Lagos Univ. (Nigeria). Dept. of Biological Sciences.
For primary bibliographic entry see Field 2H.
W87-02338

TOTAL MERCURY, METHYL MERCURY AND SULPHIDE LEVELS IN BRITISH ESTUARINE SEDIMENTS - III,
Leicester Polytechnic (England). School of Chemistry.
For primary bibliographic entry see Field 5B.
W87-02357

HEAVY METALS IN THE SEDIMENTS OF THE LOIRE ESTUARY (METAUX LOURDES DANS LES SEDIMENTS DE L'ESTUAIRE DE LA LOIRE),
Nantes Univ. (France).
For primary bibliographic entry see Field 5B.
W87-02400

MEAN SEA LEVEL - AN ELUSIVE BOUNDARY,
Santa Clara Univ., CA. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2F.
W87-02461

3. WATER SUPPLY AUGMENTATION AND CONSERVATION

3A. Saline Water Conversion

POTENTIAL FOR DESALTING IN HAMPTON ROADS, VIRGINIA,
T. M. Leahy.
IN: Is Current Technology the Answer, Proceedings of the First Biennial Conference of the National Water Supply Improvement Association, June 8-12, 1986, Washington, DC. (1986). p 29-76, 2 fig, 12 tab, 32 ref.

Descriptors: *Desalination, *Hampton Roads, *Virginia, Brackish water, Water treatment, Groundwater, Reservoirs, Environmental effects, Water supply development, Lake Gaston, Saline water, Potable water.

Five jurisdictions in Hampton Roads, Virginia, have either considered or are considering brackish water (primarily groundwater) desalting as alternatives to conventional water supply projects. On the Northside, Gloucester and James City Counties propose to construct freshwater reservoirs of 2.5 mgd (9.5 Ml/day) and 8.0 mgd (30 Ml/day), respectively. The EPA, concerned over the loss of wetlands and other environmental factors, has required that brackish water desalting of groundwater be considered as an alternative to both projects. The EPA is currently funding a feasibility study to determine whether or not desalting would have lower costs and/or lower environmental impacts than Gloucester's proposed Beaverdam Swamp Reservoir. The results of that study are expected in the fall of 1986. Regionally, the Corps of Engineers has concluded that the Northside (exclusive of Gloucester) should develop additional supplies of 40 mgd (151 Ml/day) to avoid water shortages through the year 2030. On the Southside, Chesapeake and Suffolk are proposing to construct impoundments to recover safe yield capacity that did not materialize when they developed freshwater sources during the last several years. Virginia Beach has determined that insufficient brackish groundwater exists to reliably supply its future water needs. Seawater desalting has no such quantity limit but it is cost prohibitive at this time. Based on the results of five years of study involving dozens of alternatives, Virginia Beach selected the Lake Gaston alternative (transfer of up to 60 mgd of water) as the most appropriate course of action. The Corps of Engineers has also recommended Lake Gaston as the best alternative to supply a projected water supply shortage of 55 mgd (208 Ml/day), exclusive of Suffolk, in the Southside by the year 2030. Like Virginia Beach, the Corps concluded that there is not sufficient brackish groundwater to support large scale brackish water desalting in southeast Virginia. (See also W87-02476) (Lantz-PTT)
W87-02479

REVIEW OF ELECTRODIALYSIS,
Ionics, Inc., Watertown, MA.
L. R. Schmauss.
IN: Is Current Technology the Answer, Proceedings of the First Biennial Conference of the National Water Supply Improvement Association, June 8-12, 1986, Washington, DC. (1986). p 88-116, 2 fig, 7 tab, 9 ref.

Descriptors: *Electrodialysis, *Water treatment, *Groundwater pollution, Desalination, Water quality control, Potable water, Saline water intrusion, Aquifers, Nitrates, Nitrites, Fluorides, Selenium, Organic compounds, Heavy metals.

Electrodialysis has a long and proven history for desalting brackish waters. As new challenges are faced in water treatment, new roles develop for the existing technologies. Electrodialysis is an important and capable technique for reducing the concentrations of ionic constituents found in water. The traditional role of electrodialysis for brackish water desalting for potable use will certainly continue into the future. New applications for electrodialysis continue to develop. Review of operational data for a number of electrodialysis plants illustrates the capabilities of this important technology in the strategies to meet some of the current challenges in water treatment. Some of these challenges include: salt water intrusion into fresh water aquifers, the contamination of nitrates and nitrites of well waters, fluoride control in municipal water, selenium poisoning, and contamination by organics and heavy metals. (See also W87-02476) (Lantz-PTT)
W87-02481

VAPOR COMPRESSION REVISITED,
Mechanical Equipment Co., New Orleans, LA.
R. W. Goeldner, J. M. Stewart, and S. A. Disi.
IN: Is Current Technology the Answer, Proceedings of the First Biennial Conference of the National Water Supply Improvement Association, June 8-12, 1986, Washington, DC. (1986). p 118-135, 2 fig.

Descriptors: *Desalination, *Vapor compression, *Water treatment, Reverse osmosis, Cost analysis, Performance evaluation, Pretreatment of water, Brackish water, Potable water, Thermodynamics, Water quality.

The pros and cons of the vapor compression (V.C.) cycle and the reverse osmosis (R.O.) system have been discussed and the advantages and disadvantages of both systems pointed out. These may be put as follows: (1) The present V.C. system is a very compact and easily operated unit. Most of the shortcomings of earlier designs have been identified and resolved as a result of years of development work. (2) It is ideal in areas where 'water only' plants are required and where there is a minimum of skilled labor for operation and maintenance. (3) It can be produced in packaged design up to about 400,000 GPD requiring only the minimum of foundations and hook-up on site. (4) Against R.O., it is inherently less energy efficient and it probably has a higher first cost, but it tolerates a much wider range of feedwater qualities. (5) The R.O. system is inherently simple but requires much more peripheral equipment than V.C. and overall water costs and membrane life depend greatly on efficient feedwater pretreatment equipment and the operation of same. (6) In many respects, the development of the reverse osmosis process is still in its infancy by comparison with V.C. and other thermodynamic processes and has obviously some ways to go. The main problems are not actually in the membranes themselves but more in the peripheral equipment. (7) In general, however, in order to ascertain which of the many available desalting systems are most suitable for any particular situation, each system must be considered on its own merit. Different systems may be more efficient than their competitors in specific cases and situations and direct, like -for -like comparison between systems is usually extremely difficult. (See also W87-02476) (Lantz-PTT)
W87-02482

LATEST APPLICATIONS OF MEMBRANE SEPARATION TECHNOLOGIES TO INDUSTRIAL EFFLUENT TREATMENT,
C3 International, Minneapolis, MN.
For primary bibliographic entry see Field 5D.
W87-02483

ENERGY RECOVERY IN LOW PRESSURE MEMBRANE PLANTS,
Post, Buckley, Schuh and Jernigan, Inc., Fort Myers, FL.
W. J. Conlon, and D. L. Rohe.
IN: Is Current Technology the Answer, Proceedings of the First Biennial Conference of the National Water Supply Improvement Association, June 8-12, 1986, Washington, DC. (1986). p 160-177, 4 fig, 4 ref.

Descriptors: *Energy recovery, *Membrane processes, *Water treatment facilities, *Hydraulic machinery, Pumps, Reverse osmosis, Desalination, Cost-benefit analysis, Pump turbines.

Three reverse running turbine pump submersible generator installations at low pressure brackish water reverse osmosis (RO) plants are described. Operating data and installation costs are provided for one reverse running turbine generator currently in operation, with technical details summarized for the two future installations. The advantages and disadvantages of reverse running turbine pump generators as compared with Pelton wheel impulse turbine energy recovery devices are discussed. Power recovery, cost savings and payback period calculations for the installed reverse running turbine pump are provided in this paper. Conclusions and recommendations are made regarding the application of energy recovery turbines to brackish water reverse osmosis plants. (See also W87-02476) (Author's abstract)
W87-02484

POTABLE WATER PRODUCTION WITH LOW-PRESSURE TFC REVERSE OSMOSIS MEMBRANE ELEMENTS,
UOP, Inc., San Diego, CA. Fluid Systems Div.
For primary bibliographic entry see Field 5F.
W87-02485

USE OF MULTIEFFECT VAPOR-COMPRESSION DISTILLATION TO REDUCE WATER COST AND ENERGY CONSUMPTION IN THE REDUCTION OF CONCENTRATED WASTE STREAMS VOLUME FROM WATER RECOVERY INSTALLATIONS,
California Univ., Richmond. Water Thermal and Chemical Technology Center.
For primary bibliographic entry see Field 5D.
W87-02486

RECLAMATION AND RE-USE OF DOMESTIC WASTEWATER AND REVERSE OSMOSIS REJECT WATER,
Post, Buckley, Schuh and Jernigan, Inc., Fort Myers, FL.
For primary bibliographic entry see Field 3C.
W87-02487

CASE FOR AN ALL PURPOSE BRACKISH WATER MEMBRANE,
Du Pont de Nemours (E.I.) and Co., Wilmington, DE.
For primary bibliographic entry see Field 5F.
W87-02488

DESIGN AND ECONOMIC ANALYSIS OF REVERSE OSMOSIS SYSTEMS USING APPLICATION SOFTWARE AND MICROCOMPUTERS,
DSS Engineers, Inc., Fort Lauderdale, FL.
For primary bibliographic entry see Field 5F.
W87-02489

RECOVERY OF AGRICULTURAL DRAINAGE WATER USING DESALINATION TECHNOLOGY,

Bechtel National, Inc., Washington, DC.
For primary bibliographic entry see Field 5F.
W87-02490

UNDERSTANDING WATER CHEMISTRY: THE NEED FOR IMPROVED ANALYSES IN REVERSE OSMOSIS PLANT OPERATIONS,
Goodrich (B.F.) Co., Beltsville, MD. Specialty Polymers and Chemicals Div.
For primary bibliographic entry see Field 5D.
W87-02491

YUMA DESALTING PLANT - A STATUS REPORT,
Bureau of Reclamation, Yuma, AZ. Yuma Projects Office.
K. M. Trompeter.
IN: Is Current Technology the Answer, Proceedings of the First Biennial Conference of the National Water Supply Improvement Association, June 8-12, 1986, Washington, DC. (1986). p 408-420, 6 fig, 3 tab.

Descriptors: *Desalination, *Yuma, Water treatment facilities, Arizona, Construction, Pumps, Water treatment, Hydraulic machinery.

The last major construction contract for the Yuma Desalting Plant is about half complete. The 132,000 sq ft desalting building is the major structure involved. Portions of the pretreatment plant are being tested and placed in operation. Beside the construction contract, an operation and maintenance contract is in place to provide support in start-up and development of operating plans as well as overall operation and maintenance work. All major equipment has been ordered and is on site. This list includes desalting equipment, high-pressure pumps, and energy recovery units. In addition, all exterior structural work is complete. The current status of construction and operation, are provided here, as well as information on the schedule and plans to bring the entire plant on line. Major concerns are addressed, as will plans for the 1-million-gallons/day Test Train Facility. (See also W87-02476) (Author's abstract)
W87-02494

LESSONS FROM BUILDING A LARGE EXPERIMENTAL DESALTER: PROGRESS IN SPITE OF 'MURPHY'S LAW',
R. E. Whiting, and B. E. Smith.
IN: Is Current Technology the Answer, Proceedings of the First Biennial Conference of the National Water Supply Improvement Association, June 8-12, 1986, Washington, DC. (1986). p 438-443.

Descriptors: *Desalination, *Case studies, Design standards, Construction, Reverse osmosis, Water treatment, Water treatment facilities.

This case study outlines the insight gained so far, and lessons learned, from the design, construction, and operation of a large experimental desalter -- a facility attempting to advance the 'state-of-the-art' in the reverse osmosis (R.O.) processes. In addition to noting some successes so far, it also points to pitfalls faced in attempting new technology without the hindsight of past experience. At the end of the paper is a listing of some of the things that could be done differently, were such a highly experimental project be undertaken again in the future. (See also W87-02476) (Lantz-PTT)
W87-02496

3C. Use Of Water Of Impaired Quality

EFFECT OF SULFUR-CONTAINING NITROGEN FERTILIZERS ON THE ELEMENTAL COMPOSITION OF CELERY (APIUM GRAVEOLENS) GROWN ON A POLLUTED MARSH SOIL,
Kiel Univ. (Germany, F.R.). Inst. fuer Pflanzenernaehrung und Bodenkunde.
E. Schnug, and C. Schnier.
Plant and Soil PLSOA2, Vol. 91, No. 2, p 273-278, 1986. 4 fig, 25 ref.

Descriptors: *Fertilizers, *Sulfur, *Nitrogen, *Celery, *Polluted marsh soil, *Calcareous marsh soil, *Trace element uptake, Plant physiology, Elbe River, Germany, Selenium, Arsenic, Molybdenum, Tin, Boron, Bromine, Chromium, Copper, Calcium carbonate, Soil chemistry, Cations, Ammonium sulfate, Crop yield, Toxicity.

Celery was grown on calcareous marsh soil of Elbe River (Germany) sediments polluted with municipal wastes and fertilized with sulfur-containing N fertilizers to assess the effects of these fertilizers on trace element uptake. Compared to leaves at harvest time, bulbs showed significantly lower concentrations of Mo, S, and Sb, but higher contents of B, Br and Cr, and Cu. Because the acidifying effect of the fertilizers was suppressed by the free calcium carbonate in the soil, no significant changes in concentrations of cationic trace elements were detected in plants fertilized with ammonium sulfate compared to those that received urea or calcium ammonium nitrate. In contrast, in plants receiving ammonium sulfate the conspicuous increase in total S was accompanied by a significant decrease in concentrations of up to 30% for B, Br, and Sb, 50% for As, 60% for Se, and 80% for Mo. According to these results, with crop production on contaminated soils certain plant parts may be marketable due their low tendency to accumulate toxic elements, and it may be feasible to reduce the contents of some of these elements in plants by the use of S-containing fertilizers. (Author's abstract)
W87-01781

ENHANCEMENT OF NITRATE UPTAKE AND GROWTH OF BARLEY SEEDLINGS BY CALCIUM UNDER SALINE CONDITIONS,
California Univ., Davis. Plant Growth Lab.
M. R. Ward, M. Aslam, and R. C. Huffaker.
Plant Physiology PLPHAY, Vol. 80, No. 2, p 520-524, February 1986. 4 tab, 5 fig, 4 tab, 28 ref.

Descriptors: *Saline water, *Barley, *Calcium, Nitrates, Seedlings, Potassium, Manganese, Mangnesium, Nutrients, Impaired water use, Plant growth.

The effect of Ca(2+) on NO3(-) assimilation in young barley (Hordeum vulgare L. var CM 72) seedlings in the presence and absence of NaCl was studied. Calcium increased the activity of the NO3(-) transporter under saline conditions, but had little effect under nonsaline conditions. Calcium decreased the induction period for the NO3(-) transporter under both saline and nonsaline conditions but had little effect on its apparent K(m) for NO3(-) both in the presence and absence of NaCl. The enhancement of NO3(-) transport by CA(2+) under saline conditions was dependent on the presence of Ca(2+) in the uptake solution along with the salt, since Ca(2+) had no effect when supplied before or after salinity stress. Although Mn(2+) and Mg(2+) enhanced NO3(-) uptake under saline conditions, neither was as effective as Ca(2+). In longer studies, increasing the Ca(2+) concentration in saline nutrient solutions resulted in increases in NO3(-) assimilation and seedling growth. (Author's abstract)
W87-01837

PHOSPHATE MOVEMENT IN COLUMNS OF SANDY SOIL FROM A WASTEWATER-IRRIGATED SITE,
Florida Univ., Gainesville. Dept. of Soil Science.
For primary bibliographic entry see Field 5E.
W87-02004

NEW CONCEPT FOR RECLAIMING SODIC SOILS WITH HIGH-SALT WATER,
Thessaloniki Univ., Salonika (Greece). School of Agriculture.
N. D. Misopolinos.
Soil Science SOSCAK, Vol. 140, No. 1, p 69-74, July 1985. 4 fig, 2 tab, 4 ref.

Descriptors: *Saline water, *Sodic soils, *Calcium, *Magnesium, *Soil management, *Exchangeable sodium fraction, Soil texture, Theoretical analysis, Equations.

A theoretical analysis is described of the use of high-salt water in reclaiming sodic soils by the addition of a constant quantity of Ca(2+) in every step of successive dilutions. The addition of Ca(2+) increases markedly the ratio of Ca + Mg to total concentration (R value) during the reclamation process. The equations resulting from the present theoretical analysis are used in calculating the exchangeable-sodium-fraction (ESF) and the depth of water, which are expressed in terms of the initial properties of the soil and water, and the added constant quantity of Ca(2+). A fine-textured soil of ESF = 0.41 wa reclaimed in laboratory columns with the result that the final ESF was 0.29, compared to a theoretical value of 0.297. (Rochester-PTT)
W87-02005

DISSOLUTION RATE OF GYPSUM IN AQUEOUS SALT SOLUTIONS,
Texas A and M Univ., El Paso. Agricultural Research and Extension Center.
G. R. Gobran, and S. Miyamoto.
Soil Science SOSCAK, Vol. 140, No. 2, p 89-93, August 1985. 4 fig, 1 tab, 15 ref.

Descriptors: *Gypsum dissolution, *Sodium chloride, *Magnesium chloride, *Sodium sulfate, Magnesium sulfate, *Calcium chloride, *Agitation, Egypt, New Mexico, Soil solution, Soil chemistry.

The dissolution rate of gypsum particles (0.5-1.0 mm fraction) was measured in distilled water and aqueous salt solutions of NaCl, MgCl2, Na2SO4, MgSO4, and CaCl2 at salt concentrations of 20, 40, and 60 millimol/kg. Gypsum samples from gypsum mines in Egypt and New Mexico were tested. The dissolution rate was monitored by measuring the Ca concentrations in these solutions with and without shaking. The rate of gypsum dissolution increased with shaking and with increasing concentration of the salt solutions. Neither ion concentration nor species influenced the rate of gypsum when the rate was normalized by the solubility. The first-order reaction equation was unsuited for describing the solution process when Ca concentrations exceeded about 30% of gypsum solubility. The second-order reaction equation described the process well, providing a rate constant independent of ion concentrations or species. (Author's abstract)
W87-02007

SOIL SALINITY AS AFFECTED BY HIGH-SULFATE WATER,
Agricultural Research Inst., Nicosia (Cyprus).
I. Papadopoulos.
Soil Science SOSCAK, Vol. 140, No. 5, p 376-381, November 1985. 3 fig, 4 tab, 18 ref.

Descriptors: *Saline soils, *Soil management, *Reclamation, *Leaching, *Irrigation, *Gypsum, *Sulfates, *Ions, *Clay, *Sand, Athalassa sandy clay loam, Akhelia clay loam, Zyghi clay, Sodium adsorption ratio, Permeability coefficient, Conductivity, Soil solution.

Laboratory experiments were used to evaluate salt buildup in three soils irrigated with various amounts of water high in sulfates and the good-quality water needed for reclaiming such soils. Athalassa (sandy clay loam), Akhelia (clay loam), and Zyghi (clay) soils were tested. Salt buildup occurred in two distinct stages: (1) a stage marked by a sharp increase in soil salinity as ions of both high and low solubility contributed; and (2) a second, slower stage marked by buildup linearly related to the concentration of highly soluble ions. The sodium adsorption ratio (SAR) measured in soils taken from pots at the end of salinization increased with every volume of sulfate water applied. Saturated hydraulic conductivity also increased initially, but decreased sharply later. The rate of leaching, as with salt buildup, followed two stages: (1) first soluble salts were leached rapidly, with a sharp decrease in electrical conductivity and SAR; and (2) attainment of a steady-state and a gradual decrease in soil solution EC, which was strongly dependent on gypsum dissolution. (Author's abstract)

W87-02020

DISSOLUTION OF GYPSUM IN ALKALI SOILS,
Central Soil Salinity Research Inst., Karnal (India).
R. K. Gupta, C. P. Singh, and I. P. Abrol.
Soil Science SOSCAK, Vol. 140, No. 5, p 382-386, November 1985. 5 fig, 1 tab, 10 ref.

Descriptors: *Leaching, *Reclamation, *Soil management, *Gypsum, *Alkali soils, *Soil solution, *Saline soils, *Soil water, Soil management, Zarifa Viran soil series, India, Soil chemistry, Divalent cations, Equations, Leaching, Soil horizons, Salinity, Depth, Sodicity.

Laboratory column studies were designed to evaluate the effect of depth of mixing gypsum and to generate evidence for instantaneous dissolution of gypsum, uniformly mixed at rates equal to the gypsum requirement of that soil layer. Drainage was expressed as the ratio of depths of drainage water to depth of gypsum-mixed soil (DW/DS) to scale out differences in contact time between gypsum particles and the moving water. The depth of mixing had no effect on gypsum dissolution in soil samples from the Zarifa Viran Soil Series (a Typic Natrustalf). Because of instantaneous dissolution of gypsum, the water requirement for the projected sodicity/salinity reductions in alkali soils can be computed, even without monitoring divalent cation concentrations in the drainage water. Thus, the leaching requirement of an alkali soil should provide a realistic estimate of the water required for its reclamation. (Author's abstract)
W87-02021

CROP-WATER PRODUCTION FUNCTION MODEL FOR SALINE IRRIGATION WATERS,
California Univ., Riverside. Dept. of Soil and Environmental Sciences.
J. Letey, A. Dinar, and K. C. Knapp.
Soil Science Society of America Journal SSSJD4, Vol. 49, No. 4, p 1005-1009, July-August 1985. 5 fig, 1 tab, 21 ref.

Descriptors: *Model studies, *Saline water, *Impaired water use, *Crop production, Irrigation water, Leaching, Salinity, Evapotranspiration, Irrigation practices, Tall fescue.

The relationship between crop yield and the seasonal amount of applied water is required to determine optimum irrigation management. A model was developed to determine crop-water production functions with saline irrigation waters. The model combined yield and evapotranspiration, yield and average root zone salinity, and average root zone salinity and leaching fraction. Adjustments of plant growth and evapotranspiration to root zone salinity was possible. Crop-water production functions were computed for tall fescue at various levels of salinity in irrigation waters. A comparison was made between calculated and published experimentally measured values of leaching fractions and yields of tall fescue grown under conditions of various irrigation water salinities, water application quantities and applied water frequencies. Calculated and measured yields were in good agreement but agreement between calculated and measured leaching fractions was not as good as for yields. (Khumbatta-PTT)
W87-02030

POTENTIAL FOR EVOLUTION OF SALT (NACL) TOLERANCE IN SEVEN GRASS SPECIES,
Liverpool Univ. (England). Dept. of Botany.
For primary bibliographic entry see Field 2I.
W87-02080

EXPRESSION OF TOLERANCE OF NA(+), K(+), MG(2+), CL(-), AND SO4(2-) IONS AND SEA WATER IN THE AMPHIPLOID OF TRITICUM AESTIVUM ELYTRIGIA ELONGATA,
California Univ., Davis. Dept. of Agronomy and Range Science.
For primary bibliographic entry see Field 2I.
W87-02126

COMPARATIVE TOLERANCE OF TROPICAL GRAIN LEGUMES TO SALINITY,
Commonwealth Scientific and Industrial Research Organization, St. Lucia (Australia). Div. of Tropical Crops and Pastures.
B. A. Keating, and M. J. Fisher.
Australian Journal of Agricultural Research AJAEA9, Vol. 36, No. 3, p 373-383. 3 fig, 4 tab, 29 ref.

Descriptors: *Salt tolerance, *Legumes, *Plant tissue, Grain crops, Sodium, Chlorides, Accumulation, Crop yield, Halophytes.

Salinity tolerances of tropical grain legumes were compared during early vegetative growth of plants grown in pots with sodium chloride added to a sandy soil. Salinity tolerance was determined based on electrical conductivities at 50% of maximum growth. Genotypic variations in sodium accumulation were evident with black gram, green gram and pigeon pea accumulating large quantities in shoot tissue as compared with the effective exclusion of sodium by Sesbania, guar and soybean. Chloride uptake differences between species were smaller and relative yield reduction was closely related to the amount of chloride in shoots. These results are discussed in terms of current investigations of salt tolerance in nonhalophytes. (Michael-PTT)
W87-02144

GERMINATION AND GROWTH OF SECALE MONTANUM GUSS. IN THE PRESENCE OF SODIUM CHLORIDE,
Victoria Dept. of Agriculture, Tatura (Australia). Irrigation Research Inst.
C. L. Noble.
Australian Journal of Agricultural Research AJAEA9, Vol. 36, No. 3, p 385-395, 1985. 3 fig, 1 tab, 21 ref.

Descriptors: *Salt tolerance, *Plant growth, *Secale montanum, Plant tissues, Leaves, Accumulation, Sodium chloride, Sodium, Chlorides, Potassium, Roots, Seedlings.

Salt tolerance of Secale montanum was determined at various growth stages. Tolerance during germination was high, but decreased during seedling emergence. Shoot dry weight of emerged seedlings was 64% of that of non-treated seedlings. Yield decline during later plant growth was 6 to 7% of non-saline yield. There was considerable plant-to-plant variation for shoot dry weight in the presence of salt which indicated scope for selection in increasing species salt tolerance. Osmotic adjustment was aided by a reduction in tissue water content with increasing salinity and by the accumulation of sodium and chloride. Sodium was accumulated in the roots, which increased their selectivity for potassium over sodium, and chloride was mainly accumulated in the shoots. S. montanum can be classified as moderately salt tolerant. (Michael-PTT)
W87-02145

GROWTH AND MINERAL COMPOSITION OF THE SULTANA GRAPEVINE AS INFLUENCED BY SALINITY AND ROOTSTOCK,
Commonwealth Scientific and Industrial Research Organization, Adelaide (Australia). Div. of Horticultural Research.
W. J. S. Downton.
Australian Journal of Agricultural Research AJAEA9, Vol. 36, No. 3, p 425-434, 1985. 3 fig, 3 tab, 19 ref.

Descriptors: *Salt tolerance, *Plant growth, *Grapevines, *Roots, Accumulation, Phosphorus, Magnesium, Calcium, Nitrogen, Australia, Murray River, Ions, Water reuse, Cations, Leaves, Root development.

Sultana grapevines were irrigated with chloride salt solutions under greenhouse conditions for three consecutive growing seasons. Cations accompanying chloride included sodium, magnesium and calcium. Growth was suppressed by salinity in all vines, but self-rooted and scions of Harmony and 1613 stocks gave curvilinear responses in which the rate of growth decline was greater at lower salinities. Rootstocks grown in a greenhouse generally lowered chloride concentrations in leaves of scions below that of self-rooted vines. Rootstocks lowered sodium in petioles and raised potassium concentrations in all plant parts. Phosphorus concentrations in scions were elevated by salt treatment. Magnesium showed increases in leaves and canes with increasing external salinity, but calcium did not. Nitrogen concentrations did not change with rootstocks or salt treatment. These results have implications for irrigated horticultural areas along the Murray River where the ionic composition of the watering medium was formulated and for other areas practicing saline water reuse. (Michael-PTT)
W87-02146

COMPARATIVE RESPONSE TO SALINITY OF THE GROWTH AND NODULATION OF MACROPTILIUM ATROPURPUREUM CV. SIRATRO AND NEONOTONIA WIGHTII CV. COOPER SEEDLINGS,
Commonwealth Scientific and Industrial Research Organization, St. Lucia (Australia). Div. of Tropical Crops and Pastures.
J. R. Wilson.
Australian Journal of Agricultural Research AJAEA9, Vol. 36, No. 4, p 589-599, 1985. 5 fig, 2 tab, 23 ref.

Descriptors: *Salt tolerance, *Legumes, *Plant growth, Siratro, Glycine, *Sodium, Chlorides, Accumulation, Nitrogen, Plant tissue, Nitrogen fixation, Nodulation.

Seedlings of two tropical legumes (siratro and glycine) were grown in nitrogen-free sand and exposed to 14 days of salt treatment 12 days after germination. Cowper Rhizobium CB756 was applied at either early germination (early innoculated) or at the beginning of salt treatment (late innoculated). Siratro was more salt tolerant and tolerated high chloride levels with less injury and plant deaths than glycine. Chloride concentration of leaves was more closely related to plant growth rate during recovery than was sodium concentration. Late innoculated plants were not more sensitive to salt than those treated during germination. Chloride accumulation in these plants may have been restricted by nitrogen deficiency, thus limiting tissue injury in small, slow-growing seedlings. Rhozobia survived a higher saline concentration treatment and nodulation occurred during the recovery phase. Nitrogen fixation per unit nodule weight was not greatly restricted by salt, except in cases of severe host injury. Salt ion concentrations in nodules were generally low compared with those for plant tops. (Michael-PTT)
W87-02147

HARVESTING DAPHNIA MAGNA GROWN ON URBAN TERTIARILY-TREATED EFFLUENTS,
Laval Univ., Quebec. Dept. de Biologie.
D. Proulx, and J. de la Noue.
Water Research WATRAG, Vol. 19, No. 10, p 1319-1324, 1985. 6 fig, 50 ref.

Descriptors: *Daphnia, *Municipal wastewater, *Feed, Zooplankton, Recycling, Biomass, Tertiary wastewater treatment, Harvesting, Yield.

The yield of Daphnia magna populations that were semi-continuously harvested and continuously fed with a suspension of the green microalga Scenedesmus obliquus grown in urban wastewater was measured. Non-selective harvesting leads to full expression of daphnid population growth potential and reduces size distribution instability which lowers yield. After two months of harvesting at rates of 6, 18 and 32% every three days, average harvests and corresponding population densities increased proportionately. The results demonstrate the possibility of growing Daphnia magna populations in tertiarily-treated municipal wastewater effluents to provide biomasses useful for animal feeding purposes. (Author's abstract)
W87-02163

PROGENY SCREENING OF SORGHUM PLANTS REGENERATED FROM SODIUM CHLORIDE - SELECTED CALLUS FOR SALT TOLERANCE,
Texas A and M Univ., College Station. Dept. of Soil and Crop Sciences.
S. Bhaskaran, R. H. Smith, and K. F. Schertz.
Journal of Plant Physiology JPPHEY, Vol. 122, No. 3, p 205-210, February 1986. 1 fig, 1 tab, 12 ref.

Descriptors: *Salt tolerance, *Progeny, *Sorghum, Halophytes, Tissue culture, Salt stress, Hydroponic screening, Sodium chloride.

In vitro selection using callus or suspension cultures has become a widely established tool for selection of sodium chloride (NaCl)-tolerant cell lines. The screening for salt tolerance of the progeny from a non-selected and a salt-selected plant regenerated from tissue culture has been compared with parent line grown under identical conditions. Sorghum bicolor (L.) Moench plants regenerated from callus cultures grown with and without salt (NaCl) were grown to maturity in a greenhouse. Seeds were collected after self-pollination was germinated, and the seedlings were screened in a hydroponics system for NaCl tolerance. Progeny from the salt-selected plant had slightly longer roots than the parents when grown in normal nutrient solution. Nutrient solution containing NaCl, the salt-selected progeny had a higher shoot dry matter than did the parent line. Progenies from both the parent and salt-selected lines had decreased root weights and root lengths in the presence of NaCl. This suggested that seedlings from the salt-selected plant obtained adequate nutrients to allow higher shoot dry matter accumulation than that of the parent population. (Khumbatta-PTT)
W87-02183

GLASSHOUSE SCREENING PROCEDURE FOR IDENTIFYING CITRUS HYBRIDS WHICH RESTRICT CHLORIDE ACCUMULATION IN SHOOT TISSUES,
Commonwealth Scientific and Industrial Research Organization, Merbein (Australia). Div. of Horticultural Research.
S. R. Sykes.
Australian Journal of Agriculutral Research AJAEA9, Vol. 36, No. 6, p 779-789, 1985. 3 fig, 5 tab, 22 ref.

Descriptors: *Greenhouses, *Citrus fruit, *Hybridizing, *Accumulation, *Chlorides, *Screening, Plant tissues, Seedlings.

A screening procedure for identifying new citrus hybrids which restrict chloride accumulation in shoots was replicated in four greenhouse experiments. Seedlings were grown in nutrient solution cultures containing sodium chloride and individual hybrids were selected for further evaluation on the basis of low leaf chloride concentrations and visual evidence of salt damage. Four hybrids were selected from two crosses, Rangpur lime x Trifoliate orange and Cleopatra mandarin x Carrizo citrange. Mean leaf chloride concentration of replicated hybrids was positively correlated with those measured for each hybrid in the original screening experiment. These results demonstrate that the original screening experiments are reliable and accurate. (Michael-PTT)
W87-02222

GRAIN SORGHUM STILLAGE RECYCLING: EFFECT ON ETHANOL YIELD AND STILLAGE QUALITY,
Texas A and M Univ., College Station. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 5D.
W87-02238

LIQUID SLUDGE VS. NITROGEN FERTILIZER,
Colorado State Univ., Fort Collins. Dept. of Agronomy.
J. M. Utschig, K. A. Barbarick, D. G. Westfall, R. H. Follett, and T. M. McBride.
Biocycle BCYCDK, Vol. 27, No. 7, p 30-33, August 1986. 4 tab, 13 ref.

Descriptors: *Sludge utilization, *Nitrogen, *Fertilizers, Wheat, Colorado, Crop yield, Proteins, Zinc, Lead, Cadmium, Chromium, Curium, Accumulation, Retention, Soil water, Trace metals.

Sewage sludge low in metal was applied to dryland wheat crops in eastern Colorado to determine its impact on crop yield and protein content as compared with results using commercial nitrogen fertilizer. Zinc, lead, cadmium, chromium and curium plant uptake and soil accumulation was also studied and changes in soil-water retention were monitored. Sludge application was beneficial for soil water retention and plant nutrient reuse. Higher protein content was obtained without causing significant concentrations of trace metals in plants. Accumulation effects will be investigated over the next two years following a second application of sludge. (Michael-PTT)
W87-02243

BIOLOGICAL TREATMENT OF CHEMICAL INDUSTRY EFFLUENTS BY STABILIZATION PONDS,
Ben-Gurion Univ. of the Negev, Sde Boker (Israel). Jacob Blaustein Inst. for Desert Research.
For primary bibliographic entry see Field 5D.
W87-02394

RECLAMATION AND RE-USE OF DOMESTIC WASTEWATER AND REVERSE OSMOSIS REJECT WATER,
Post, Buckley, Schuh and Jernigan, Inc., Fort Myers, FL.
V. M. Riccobono, D. L. Rohe, and J. T. Petty.
IN: Is Current Technology the Answer, Proceedings of the First Biennial Conference of the National Water Supply Improvement Association, June 8-12, 1986, Washington, DC. (1986). p 252-267, 1 fig, 2 tab.

Descriptors: *Wastewater renovation, *Impaired water use, *Domestic wastes, *Reverse osmosis, Effluents, Spray irrigation, Case studies, Water quality, Cost-benefit analysis.

Reuse of a combination of domestic wastewater effluent and reverse osmosis reject (concentrate) water by spray irrigation is detailed in this paper. A case history is provided, including economics, water quality parameters, flows and environmental regulatory requirements, for spray irrigation reuse of wastewater streams at a planned unit development in southwest Florida. Costs associated with effluent and concentrate disposal as well as the recycle program are estimated. Advantages (such as lower costs to develop the wellfield, lower capital and operation/maintenance costs to produce potable water) and disadvantages (water quality) of the reuse system are highlighted. (See also W87-02476) (Author's abstract)
W87-02487

SALINE WATER USE IN POWERPLANTS - CASE STUDIES,
Bureau of Reclamation, Denver, CO.
M. Bessler, J. Kaakinen, J. Laughlin, and R. Schroeder.
IN: Is Current Technology the Answer, Proceedings of the First Biennial Conference of the National Water Supply Improvement Association, June 8-12, 1986, Washington, DC. (1986). p 382-407, 9 fig, 1 tab, 14 ref.

Descriptors: *Saline water, *Powerplants, *Case studies, Impaired water use, Hunter Station, Jim Bridger Power Plant, Colorado River, Salinity, Water quality control, Cost analysis, Ion exchange, Water softening, Cooling towers.

Two case studies conducted at Hunter Station and Jim Bridger Power Plant, to assess power plant salinity control, were essentially constrained to retrofit situations. Process selection, materials, and plant modifications required for an existing plant may be dramatically different from a potential new plant with basic design options still available. Within context of the next generation of planned powerplants, opportunities for using a total or blended saline water supply, new materials applications, and process optimization offer cost reductions as compared to case study estimates. In terms of salinity control cost effectiveness, total in-plant costs developed from the two case studies for the most viable options ranged from $70 to $107 per ton. In terms of water supply costs, in comparing a freshwater source to saline water, the total in-plant cost difference amounted to $475 per acre-foot per year for the most viable option. Aside from addressing the detailed costs and economics of saline water treatment, the studies identified commercial as well as emerging technology applicable for saline water use. For example, it was determined that the binary cooling tower (direct saline water cooling) was not cost competitive with other existing 'on-the-shelf' equipment to accomplish the same general objective. At the same time, however, the emerging technologies of lime/soda sidestream softening and ion exchange softening appear to offer the best economic promise for powerplant application. Uncertainties remain for both processes primarily in terms of operational experience under high total dissolved solids conditions. (See also W87-02476) (Lantz-PTT)
W87-02493

SALTY COLORADO,
John Muir Inst. for Environmental Studies, Inc., Napa, CA.
For primary bibliographic entry see Field 5B.
W87-02561

3D. Conservation In Domestic and Municipal Use

EFFECTIVENESS OF DROUGHT POLICIES FOR MUNICIPAL WATER MANAGEMENT,
Nevada Univ., Reno. Dept. of Agricultural Economics.
For primary bibliographic entry see Field 6D.
W87-01912

CRITICAL ANALYSIS OF RESIDENTIAL FLOOD DAMAGE ESTIMATION CURVES,
Waterloo Univ. (Ontario). Dept. of Civil Engineering.
For primary bibliographic entry see Field 6F.
W87-02376

3E. Conservation In Industry

DYNAMICS OF EXTRACTABLE PHOSPHORUS DURING NONSTERILE AND STERILE INCUBATION OF SLUDGE-AMENDED SOIL,
New Mexico State Univ., Las Cruces. Dept. of Crop and Soil Sciences.
For primary bibliographic entry see Field 5C.
W87-02008

1982 CENSUS OF MINERAL INDUSTRIES: WATER USE IN MINERAL INDUSTRIES,
Bureau of the Census, Washington, DC.
For primary bibliographic entry see Field 6D.
W87-02543

3F. Conservation In Agriculture

NITROGEN FIXATION BY NON-LEGUMES IN TROPICAL AGRICULTURE WITH SPECIAL REFERENCE TO WETLAND RICE,
International Rice Research Inst., Los Banos, Laguna (Philippines). Soil Microbiology Dept.
For primary bibliographic entry see Field 2I.
W87-01772

LABORATORY ACETYLENE REDUCTION ASSAY FOR RELATIVE MEASUREMENT OF N2-FIXING ACTIVITIES ASSOCIATED WITH FIELD-GROWN WETLAND RICE PLANTS,

International Rice Research Inst., Los Banos, Laguna (Philippines). Soil Microbiology Dept.
For primary bibliographic entry see Field 2I.
W87-01773

EFFECT OF INCORPORATION OF CROP RESIDUES ON DEVELOPMENT OF DIAZOTROPHS AND PATTERNS OF ACETYLENE-REDUCING ACTIVITY IN NILE VALLEY SOILS,
Cairo Univ., Giza (Egypt). Faculty of Agriculture.
For primary bibliographic entry see Field 2G.
W87-01774

GROWTH OF VIGNA UNGUICULATA L. VAR. GWL K3B IN SUB-OPTIMAL MOISTURE CONDITIONS AS INFLUENCED BY CERTAIN ANTITRANSPIRANTS,
Jiwaji Univ., Gwalior (India). School of Studies in Botany.
R. M. Agarwal, R. R. Das, and R. A. S. Chauhan.
Plant and Soil PLSOA2, Vol. 91, No. 1, p 31-42, 1986. 2 fig, 11 tab, 30 ref.

Descriptors: *Cowpea, *Antitranspirants, *Phosphon-D, *Maleic hydrazide, *Soil moisture deficiency, Seedling survival, Plant growth, Plant physiology, Chlorophyll, Water stress.

The effects of the antitranspirants 2,4-dichorobenzyl-tributyl-phosphonium chloride (Phosfon-D) and 2-chloroethyl-trimethyl ammonium chloride (CCC) on the growth of Vigna unguiculata (cowpea) grown under suboptimal soil moisture conditions were recorded. Effects of maleic hydrazide, Phosfon-D, and CCC on growth also are described. Growth effects observed, eg, seedling survival percentage, shoot growth, root growth, stomatal index, and chlorophyll content, indicated that application of CCC and Phosfon-D can help plants to a certain extent to withstand the effects of suboptimal soil moisture conditions. (Author's abstract)
W87-01775

RESPONSE OF SORGHUM AND SUNFLOWER TO SHORT-TERM WATERLOGGING: IV. WATER AND NUTRIENT UPTAKE EFFECTS,
University of New England, Armidale (Australia). Dept. of Agronomy and Soil Science.
For primary bibliographic entry see Field 2I.
W87-01777

ENHANCEMENT OF WATER STATUS BY CALCIUM PRETREATMENT IN GROUNDNUT AND COWPEA PLANTS SUBJECTED TO MOISTURE STRESS,
University of Agricultural Sciences, Bangalore (India). Dept. of Crop Physiology.
For primary bibliographic entry see Field 2I.
W87-01778

EFFECT OF STRAW EXTRACT ON WATER ABSORPTION AND GERMINATION OF WHEAT (TRITICUM AESTIVUM L. VARIETY RR-21) SEEDS,
Govind Ballabh Pant Univ. of Agriculture and Technology, Pantnagar (India). Dept. of Soil Science.
P. C. Srivastava, N. G. Totey, and O. Prakash.
Plant and Soil PLSOA2, Vol. 91, No. 1, p 143-145, 1986. 1 fig, 1 tab, 7 ref.

Descriptors: *Wheat, *Seed germination, *Straw, *Soil organic matter, *Rotted straw, Plant physiology, Plant pathology.

Freshly-prepared straw extract inhibited wheat seed germination by about 18%, but did not affect water absorption by germinating wheat seeds. The maximum germination inhibition (47%) was noticed with extract of straw rotted for 15 days. The germination-inhibitory effect of rotting straw was nil at 31 days of straw rotting. (Author's abstract)
W87-01779

ROOT GROWTH OF SOYBEAN (GLYCINE MAX L. MERR.) AND COWPEA (VIGNA UNGUICULATA WALP.) ON A HYDROMORPHIC TOPOSEQUENCE IN WESTERN NIGERIA,
International Inst. of Tropical Agriculture, Ibadan (Nigeria).
For primary bibliographic entry see Field 2I.
W87-01780

EFFECT OF SULFUR-CONTAINING NITROGEN FERTILIZERS ON THE ELEMENTAL COMPOSITION OF CELERY (APIUM GRAVEOLENS) GROWN ON A POLLUTED MARSH SOIL,
Kiel Univ. (Germany, F.R.). Inst. fuer Pflanzenernaehrung und Bodenkunde.
For primary bibliographic entry see Field 3C.
W87-01781

ETHYLENE AND ETHANE RELEASE DURING TOBACCO PROTOPLAST ISOLATION AND PROTOPLAST SURVIVAL POTENTIAL IN VITRO,
University Coll., Cork (Ireland). Dept. of Plant Science.
For primary bibliographic entry see Field 2I.
W87-01783

EFFECTS OF N NUTRITION ON THE WATER RELATIONS AND GAS EXCHANGE CHARACTERISTICS OF WHEAT (TRITICUM AESTIVUM L.),
Agricultural Research Service, Fort Collins, CO.
For primary bibliographic entry see Field 2I.
W87-01830

OSMOTIC RESPONSE OF SUGAR BEET SOURCE LEAVES AT CO2 COMPENSATION POINT,
Dayton Univ., OH. Dept. of Biology.
For primary bibliographic entry see Field 2I.
W87-01831

WATER STRESS ENHANCES EXPRESSION OF AN ALPHA-AMYLASE GENE IN BARLEY LEAVES,
Commonwealth Scientific and Industrial Research Organization, Campbell (Australia).
For primary bibliographic entry see Field 2I.
W87-01835

COMPARISON OF THE SUBMERGENCE RESPONSE OF DEEPWATER AND NON-DEEPWATER RICE,
MSU/DOE Plant Research Lab., East Lansing, MI.
K. A. Keith, I. Raskin, and H. Kende.
Plant Physiology PLPHAY, Vol. 80, No. 2, p 479-482, February 1986. 2 tab, 1 fig, 2 tab, 9 ref.

Descriptors: *Rice, *Submergence, *Plant growth, Ethylene, Oxygen, Carbon dioxide, Nitrogen, Water depth, Flooding, Flood irrigation.

Twelve cultivars of rice (Oryza sativa L.), representing deepwater, short-statured, and semidwarf types, were tested for their response to submergence. The magnitude of the response varied between cultivars. however, all cultivars responded to submergence by rapid growth once internodal elongation had started. Three of these cultivars were tested for elongation capacity at four ages. The deepwater rice was capable of rapid internodal elongation in response to submergence at 4 weeks of age. Growth of the short-statured and semidwarf cultivars was not stimulated by submergence until about 10 weeks of age. In air, the internodes of deepwater rice grew slower than did those of the short-statured and semi-dwarf cultivars. The elongation response of stem sections of all 12 cultivars to an atmosphere containing 3% O2, 6% CO2, 91% N2 (all by volume), and 1 microliter/liter ethylene was investigated. The response of each of the non-deepwater cultivars was qualitatively and quantitively similar to that of the deep-water rice. (Author's abstract)
W87-01836

INCREASED ABSCISIC ACID BIOSYNTHESIS DURING PLANT DEHYDRATION REQUIRES TRANSCRIPTION,
Texas A and M Univ., College Station. Dept. of Biochemistry and Biophysics.
For primary bibliographic entry see Field 2I.
W87-01838

MEMBRANES OF SLOWLY DROUGHT-STRESSED WHEAT SEEDLINGS: A FREEZE-FRACTURE STUDY,
Newcastle upon Tyne Univ. (England). Dept. of Agricultural Biology.
For primary bibliographic entry see Field 2I.
W87-01839

VALUATION OF IMPROVED IRRIGATION EFFICIENCY FROM AN EXHAUSTIBLE GROUNDWATER SOURCE,
Texas A and M Univ., College Station. Dept. of Agricultural Economics and Rural Sociology.
J. G. Lee, J. R. Ellis, and R. D. Lacewell.
Water Resources Bulletin WARBAQ, Vol. 21, No. 3, p 441-447, June 1985. 6 tab, 15 ref.

Descriptors: *Irrigation efficiency, *Taxes, *Groundwater, Low Energy Precision Application Systems, Texas High Plains, Ogallala Aquifer, Cotton, Sorghum, Wheat, Corn, Sunflowers, Soybeans, Crop pieces, Irrigation systems.

The value of improving irrigation application efficiency from a limited groundwater source is estimated. Techniques which maximize the present value of net revenue over a 20-year planning horizon under different output price scenarios and initial groundwater situations are identified. Net benefits were derived for different application efficiency levels under furrow, sprinkler, and Low Energy Precision Application Systems (L.E.P.A.) irrigation systems. In addition, net benefit estimates were obtained for the transition across irrigation systems. Data was obtained from the Texas High Plains, approximately 35,000 square miles in 42 counties. The principal source of irrigation water on the High Plains is the underlying Ogallala Aquifer. The climate has a relatively low and erratic rainfall pattern with a wide variation in daily and seasonal temperatures. The crops include cotton, sorghum, wheat, corn, sunflowers, and soybeans. Each crop has several irrigation options including both optimal and nonoptimal timings. Dry land options exist for all crops except for corn and soybeans. Solutions from the model indicate that low crop prices have a differential impact on net benefits across irrigation application efficiencies and irrigation systems. Also, the more limited groundwater situations consistently reduce the economic incentive to adopt improved irrigation application techniques across all irrigation systems. (Peters-PTT)
W87-01916

ESTIMATES OF THE ECONOMIC VALUE PRODUCTIVITY OF IRRIGATION WATER IN PAKISTAN FROM FARM SURVEYS,
Agency for International Development, Karachi (Pakistan).
For primary bibliographic entry see Field 6C.
W87-01937

DEMAND IRRIGATION SCHEDULE PILOT PROJECT: SRI LANKA,
California Polytechnic State Univ., San Luis Obispo. Dept. of Architectural Engineering.
J. L. Merriam, and G. G. Davids.
Journal of Irrigation and Drainage Engineering (ASCE) JIDEDH, Vol. 112, No. 3, p 185-202, August 1986. 9 fig, 6 tab, 8 ref.

Descriptors: *Irrigation, *Sri Lanka, *Water conservation, *Irrigation design, Conservation, Agriculture, Water supply, Economic aspects, Crop production, Cost analysis, Construction.

Since 1981, the Sri Lanka Government has been testing a different approach to delivering irrigation water to its numerous small-scale farmers. Instead

of conventional open-channel rotation irrigation with water controlled by government organizations, a 367-acre pilot project has put each farmer in control of his own water supply using a limited-rate demand irrigation schedule. This system utilizes sloping canals, on-stream regulating reservoirs, automatic float-controlled canal gates, level-top canals, and buried concrete pipelines with float valves to maintain low pressure. Construction costs and materials are discussed, the four cropping seasons are evaluated, and the advantages and disadvantages are compared to conventional irrigation. It is concluded that: an adequate and equitable water supply can be achieved and sustained; crop production can be increased from 8 to 20 bushels/acre; the potential exists for reducing water use below that of conventional irrigation; and farmer contention is nearly eliminated. Project cost was about 5,860 rupees/acre compared to 3,350 rupees/acre for the conventional system. The resulting incremental increased cost is about 75% at the distributory channel level but about only 7-10% of total project development costs. (Author's abstract)
W87-01949

EMITTER SPACING AND GEOMETRY OF WETTED SOIL VOLUME,
Technion - Israel Inst. of Tech., Haifa. Dept. of Agricultural Engineering.
M. Schwartzman, and B. Zur.
Journal of Irrigation and Drainage Engineering JIDEDH, Vol. 112, No. 3, p 242-253, August 1986. 4 fig, 1 tab, 9 ref.

Descriptors: *Emitters, *Drip irrigation, *Irrigation design, *Wetting, *Irrigation efficiency, Irrigation, Irrigation engineering, Engineering, Mathematical studies, Sensitivity analysis, Soil properties.

A method was developed for determining the width and depth of the wetted soil volume under drip irrigation emitters. Soil water flow can be described as a line source or point source depending on the distance between emitters. For line sources, wetted soil volume depends on the hydraulic conductivity of the soil, source discharge per unit length, and total amount of soil water per unit length. Empirical expressions relating wetted width and depth to these parameters obtained from the results of plane flow model simulation agreed well with laboratory results. For point sources, wetted soil volume depends on hydraulic conductivity of the soil, emitter discharge, and the total amount of water in the soil. Empirical expressions relating wetted depth and width to these parameters were obtained from cylindrical flow model simulation experiments; these equations have not been tested in the field. A procedure was developed for computing optimal emitter spacing based on the geometry of the wetted soil volume and the cost of the irrigation lateral. (Doria-PTT)
W87-01953

THROTTLE HOSE, AN AUTOMATIC DIVERSION DEVICE WITH CONSTANT DISCHARGE FOR IRRIGATION CHANNELS (LE MANCHON SOUPLE D'ETRANGLEMENT, OGANE AUTOREGULATEUR DE REPARTITION DE DEBITS CONSTANTS DANS LES CANAUX D'IRRIGATION),
Eidgenoessische Technische Hochschule, Zurich (Switzerland). Versuchsanstalt fuer Wasserbau, Hydrologie und Glaziologie.
D. Vischer, and P. Peter.
La Houille Blanche, Vol. 85, No. 2, p 123-132, 1985. 12 fig, 1 tab 3 ref.

Descriptors: *Irrigation, *Throttle hose, *Diversion, Dimensioning, Irrigation engineering, Cost analysis, Automation, Togo, Perimeter Irrigation.

The throttle hose is a new automatic diversion device with constant discharge for use in irrigation networks. Its theory and operation are described and laboratory tests conducted on a variety of prototypes are discussed. Problems specific to the throttle hose also are considered, and a dimensioning process based on a simple diagram is included. The configuration of the throttle hose is simple, resulting in moderate implementation costs. An installation and testing of the throttle hose in Togo in a perimeter irrigation system at Eyadema a Mango is described. (Rochester-PTT)
W87-01968

EFFECT OF IRRIGATION METHOD AND ACETYLENE EXPOSURE ON FIELD DENITRIFICATION MEASUREMENTS,
Brigham Young Univ., Provo, UT. Dept. of Soil Microbiology.
For primary bibliographic entry see Field 2G.
W87-01991

EARTHWORMS AS A FACTOR IN THE REDUCTION OF SOIL CRUSTING,
National Soil Erosion Lab., West Lafayette, IN.
E. J. Kladivko, A. D. Mackay, and J. M. Bradford.
Soil Science Society of America Journal SSSJD4, Vol. 50, No. 1, p 191-196, January-February 1986. 3 fig, 3 tab, 23 ref.

Descriptors: *Earthworms, *Soil crusting, *Aggregate stability, *Infiltration rate, Raub silt loam, Crop residues, Corn seedling emergence, Simulated rainfall.

The effect of earthworms (Lumbricus rubellus) on the aggregate stability and infiltration rate of a Raub silt loam (Aquic Argiudolls) was studied and the susceptibility of this soil to crusting was assessed in a 54-day greenhouse experiment using 16-liter pots. Either 0, 15, or 30 earthworms per pot (0, 250, or 500/sq m) were added to pots to which no residue, soybean residue, or corn residue had been added. Earthworms increased both mean weight diameters and water-stable aggregates >2 mm when determined on initially moist soil. In the absence of earthworms, steady-state infiltration rates were 22 micron (um)/sec; the presence of earthworms at rates of 15 and 30/pot in soil containing crop residues increased these rates to 181 and 328 um/sec, respectively. Ten days after planting and simulated rainfall (6.25 cm/hr), 85-100% of corn seedlings had emerged in the undisturbed soil in which earthworms were active, whereas in the absence of earthworms only 50-52% of seedlings had emerged. When the sieved soil that had received residues and earthworms was exposed to simulated rainfall, 40-73% of seedlings had emerged at 10 days, and by 16 days 80-88% had emerged. This compares with 38% emergence in soil to which neither residue nor earthworms was added. (Author's abstract)
W87-01996

FACTORS AFFECTING THE STABILITY OF SOIL CRUSTS IN SUBSEQUENT STORMS,
Agricultural Research Organization, Bet-Dagan (Israel).
G. Levy, I. Shainberg, and J. Morin.
Soil Science Society of America Journal SSSJD4, Vol. 50, No. 1, p 196-201, January-February 1986. 6 fig, 2 tab, 13 ref.

Descriptors: *Soil crusts, *Storms, *Drying, *Infiltration rate, Exchangeable sodium percentage, Salinity, Impact energy, Conductivity, Simulated rain, Rain energy levels.

The hypothesis that the stability of the soil crust to drying depends on the processes predominating during crust formation was tested by studying the effect of application of distilled water (DW) and saline water (SW: conductivity 5 dSiemens/m) on the infiltration rates (IR) of a crusted soil surface. A Typic Rhodoxeralf and a Calcic Haploxeralf saturated with low (<3.5) and high (17 < ESP < 20) exchangeable sodium percentages (ESP) were exposed to simulated rain of high and low energy levels. The soils were oven-dried at 35C for 24 and 72 hr between consecutive storms. The crusts of soils with low ESP exposed to DW and SW rain and the crust of a soil with high ESP exposed to SW were unstable and affected strongly by (1) the salinity of the rain water in subsequent storms, (2) the impact energy of the raindrops, and (3) the length of the drying period between consecutive storms. Conversely, a crust in which chemical dispersion supplemented physical dispersion (ie, a soil with high ESP exposed to DW rain) was stable and was less affected by the water salinity of the subsequent storm, but its impact energy, or by the extent of drying between storms. (Author's abstract)
W87-01997

PHYSICAL AND CHEMICAL PROPERTIES OF A HAPLOXEROLL AFTER FIFTY YEARS OF RESIDUE MANAGEMENT,
Agricultural Research Service, Pendleton, OR. Columbia Plateau Conservation Research Center.
J. L. Pikul, and R. R. Allmaras.
Soil Science Society of America Journal SSSJD4, Vol. 50, No. 1, p 214-219, January-February 1986. 7 fig, 2 tab, 28 ref.

Descriptors: *Winter wheat, *Crop residue, *Ammonium nitrate, *Mulch, *Straw, *Burning, *Tillage pan, Pendleton, Oregon, Bulk density, Acidity, Soil horizons, Organic carbon, Soil development, Soil compaction, Soil chemistry, Permeability coefficient, Infiltration.

The effects of different crop residue management treatments were assessed on plots established in 1931 in Pendleton, Oregon; a winter wheat-fallow system was used with the following residue treatments: (1) straw, (2) straw plus 22 Mg/ha strawy manure, (3) straw burned in the fall, and (4) straw plus 90 kg N/ha as NH4NO3, broadcast before seeding. Straw return in treatments 1, 2, and 4 depended especially on the N added. Soil compaction was greatest in the control and fall burn (3) treatments, where organic C addition was least. At tillage pan depths, soil bulk density was 1.3, 1.2, 1.3, and 1.2 Mg/cu m for treatments 1, 2, 3, and 4, respectively. Crop residue management and fertilization with NH4(+) base fertilizer had a marked effect on soil pH in the Ap horizon. On the treatments without inorganic fertilizer, soil pH decreased with decreasing organic C addition; respective pH values in the Ap horizon for the 2, 1, and 3 treatments were, respectively, 6.1, 5.6, and 5.4. With treatment 4, soil pH in the Ap horizon was 4.8. Soil water desorption characteristics of the tillage pan generally were ordered according to the degree of soil compaction. Saturated hydraulic conductivity measurements identified the tillage pan in all treatments as being restrictive to water intake. Tillage pan saturated hydraulic conductivity on treatment 2 was three times greater than that of the other residue treatments. (Rochester-PTT)
W87-01999

FIELD MEASUREMENT OF DENITRIFICATION IN IRRIGATED SOILS,
Brigham Young Univ., Provo, UT. Dept. of Agronomy and Horticulture.
For primary bibliographic entry see Field 2G.
W87-02001

NEW CONCEPT FOR RECLAIMING SODIC SOILS WITH HIGH-SALT WATER,
Thessaloniki Univ., Salonika (Greece). School of Agriculture.
For primary bibliographic entry see Field 3C.
W87-02005

SPATIAL VARIABILITY OF SOIL WATER TENSION IN AN IRRIGATED SOIL,
New Mexico State Univ., Las Cruces. Dept. of Crop and Soil Sciences.
For primary bibliographic entry see Field 2G.
W87-02009

EFFECTS OF SUBSOILING AND IRRIGATION ON CORN PRODUCTION,
North Carolina State Univ. at Raleigh. Dept. of Soil Science.
For primary bibliographic entry see Field 2G.
W87-02029

CROP-WATER PRODUCTION FUNCTION MODEL FOR SALINE IRRIGATION WATERS,
California Univ., Riverside. Dept. of Soil and En-

vironmental Sciences.
For primary bibliographic entry see Field 3C.
W87-02030

NITRATE LEACHING THROUGH SANDY SOIL AS AFFECTED BY SPRINKLER IRRIGATION MANAGEMENT,
Nebraska Univ., North Platte. Dept. of Agronomy.
G. W. Hergert.
Journal of Environmental Quality JEVQAA, Vol. 15, No. 3, p 272-278, July-September 1986. 2 fig, 9 tab, 22 ref.

Descriptors: *Nitrates, *Leaching, *Sandy soils, *Sprinkler irrigation, Soil water, Evapotranspiration, Percolation, Seasonal variation, Fertilization, Crop yield, Scheduling, Corn, Precipitation.

Nitrogen leaching losses from sprinkler applied nitrogen in a sandy soil corn crop were quantified to improve fertilizer nitrogen and irrigation management. Irrigation rates were 85% and 130% of evapotranspiration. Total dry matter, grain yield and fertilizer nitrogen uptake were not significantly affected by irrigation level. Higher soil water percolation and NO3-N losses observed in 1977 resulted from over-winter precipitation and early spring leaching of the previous year's residual nitrate. Seasonal leaching was reduced by matching irrigation to evapotranspiration. Nitrogen fertilizer rates must match crop yield requirements to reduce NO3-N leaching and soil NO3-N carryover. Irrigation scheduling must also be practiced with crops grown in sandy soils. (Michael-PTT)
W87-02092

WATER USE, FOLIAGE TEMPERATURE AND YIELD OF IRRIGATED WHEAT IN SOUTH-EASTERN AUSTRALIA,
Agricultural Research Service, Bushland, TX. Conservation and Production Lab.
J. L. Steiner, R. C. G. Smith, W. S. Meyer, and J. A. Adeney.
Australian Journal of Agricultural Research AJAEA9, Vol. 36, No. 1, p 1-11, 1985. 4 fig, 5 tab, 28 ref.

Descriptors: *Evapotranspiration, *Crop yield, *Foliage temperature, *Irrigation practices, Australia, Wheat, Regression analysis, Plant growth, Plant water potential.

The relationship between evapotranspiration and grain yield was quantified in an experiment in which wheat was grown at an Australian irrigation research center with water treatments of no irrigation and irrigation at 40, 70 and 90% of soil water depletion. Irrigation affected total dry matter, grain yield and yield components such as number of heads per square meter, number of grains per head, individual grain mass and harvest index. Plot grain yields were closely related to dry matter at anthesis and number of grains per square meter which indicated the importance of early growth on final yield. Regression analysis showed a significant linear relationship between evapotranspiration and total grain dry matter. Foliage temperatures were monitored at noon and showed promise as plant stress indicators. The mean differential between foliage and air temperature from jointing to late grain fill showed a strong negative linear relationship to grain numbers per unit of soil area and to final yield. (Michael-PTT)
W87-02136

EFFECTS OF POST-TRANSPLANT WATER DEFICITS ON LEAF DEVELOPMENT AND YIELD OF WINTER PLANTED TOBACCO IN NORTH QUEENSLAND,
Queensland Dept. of Primary Industries,Mareeba (Australia). Southedge Tobacco Research Station.
For primary bibliographic entry see Field 2I.
W87-02137

ROOT CHARACTERISTICS OF SOME TEMPERATE LEGUME SPECIES AND VARIETIES ON DEEP, FREE-DRAINING ENTISOLS,
Western Australia Dept. of Agriculture, South Perth. Plant Research Div.
For primary bibliographic entry see Field 2I.
W87-02138

FURROW IRRIGATION OF GRAIN SORGHUM IN A TROPICAL ENVIRONMENT. I. INFLUENCE OF PERIOD OF INUNDATION AND NITROGEN FERTILIZER ON DRY MATTER PRODUCTION, GRAIN YIELD AND SOIL AERATION,
Queensland Dept. of Primary Industries,Mareeba (Australia). Southedge Tobacco Research Station.
For primary bibliographic entry see Field 2I.
W87-02139

FURROW IRRIGATION OF GRAIN SORGHUM IN A TROPICAL ENVIRONMENT. II. INFLUENCE OF PERIOD OF INUNDATION ON THE UTILIZATION OF SOIL AND FERTILIZER NITROGEN BY THE CROP,
Commonwealth Scientific and Industrial Research Organization, Kununurra (Australia). Kimberley Research Station.
For primary bibliographic entry see Field 2I.
W87-02140

EFFECT OF IRRIGATION ON SOIL OXYGEN STATUS AND ROOT AND SHOOT GROWTH OF WHEAT IN A CLAY SOIL,
Commonwealth Scientific and Industrial Research Organization, Griffith (Australia).
For primary bibliographic entry see Field 2G.
W87-02141

EFFECT OF SOWING TIME ON GROWTH, YIELD AND WATER-USE OF RAIN-FED WHEAT IN THE WIMMERA, VIC.,
Victoria Dept. of Agriculture, Werribee (Australia). Animal Research Inst.
G. J. O'Leary, D. J. Connor, and D. H. White.
Australian Journal of Agricultural Research AJAEA9, Vol. 36, No. 2, p 187-196, 1985. 6 fig, 3 tab, 16 ref.

Descriptors: *Water use efficiency, *Wheat, *Australia, *Crop yield, Soil water potential, Biomass, Phenology, Plant growth, Accumulation, Crop production.

Development, growth and water balance of three rain-fed wheat crops were measured during a field study in the Wimmera district of Australia to determine the effect of sowing time on grain yield. Total above ground biomass and soil water content were measured monthly for each crop from sowing to anthesis and every two weeks thereafter. The duration of the phenophase from sowing to anthesis varied from 88 to 163 days, but the maximum difference in anthesis between early and late sown crops was only 21 days. Phenophase duration was best described by a photothermal unit of 6846 day-degree-hours. Biomass accumulation varied markedly between crops as did total was use efficiency in the production of biomass to anthesis and in the seasonal production of grain. It was possible to identify an optimum balance between pre- and post-anthesis in drops sown in June, the recommended sowing time for mid-season cultivars. (Michael-PTT)
W87-02142

CONTROL OF SCHISTOSOMIASIS IN THE NEW RAHAD IRRIGATION SCHEME OF CENTRAL SUDAN,
Blue Nile Health Project, Wad Medani (Sudan).
For primary bibliographic entry see Field 5F.
W87-02181

DEGRADATION OF TERBUFOS IN SOIL AND ITS TRANSLOCATION INTO COLE CROPS,
For primary bibliographic entry see Field 5B.
W87-02371

4. WATER QUANTITY MANAGEMENT AND CONTROL

4A. Control Of Water On The Surface

PHYTOPLANKTON RESPONSE TO FRESHWATER RUNOFF: THE DIVERSION OF THE EASTMAIN RIVER, JAMES BAY,
McGill Univ., Montreal (Quebec). Inst. of Oceanography.
For primary bibliographic entry see Field 5C.
W87-01794

FUNDY TIDAL POWER DEVELOPMENT AND POTENTIAL FISH PRODUCTION IN THE GULF OF MAINE,
Maine State Dept. of Marine Resources, West Boothbay Harbor.
D. E. Campbell, and J. S. Wroblewski.
Canadian Journal of Fisheries and Aquatic Sciences CJFSBX, Vol. 43, No. 1, p 78-89, January 1986. 6 fig, 1 tab, 42 ref, append. National Marine Fisheries Service, Contract NA-83-FA-C-00047; NSF Grant OCE-8421026.

Descriptors: *Hydroelectric plants, *Tidal amplitude, *Primary production, *Phytoplankton, *Mathematical models, *Zooplankton, *Fish, Climate, *Marine fisheries, *Bay of Fundy, *Gulf of Maine, Canada, Wind, Vertical mixing, Fish management.

The possible effects of tidal amplitudes altered by Fundy tidal power development upon potential fish production in the Gulf of Maine were examined with a marine ecosystem model. Three areas off the Maine coast were delineated on the basis of winds, tides, and the extent of vertical mixing. An optimum kinetic energy from wind and tide exist for maximum primary production in the water column. Primary production in the model is the base for a simple pelagic food chain leading from phytoplankton through zooplankton to fish. If the construction of a tidal power dam in the upper Bay of Fundy results in a 5-10% increase in tidal amplitude, the present first-order model predicts that enhanced vertical mixing from May to October will increase potential fish production along the Maine west coast by 7-12%. Fish production along the Maine east coast and in offshore waters is predicted to remain at present levels. Climatic variation is predicted to have as large an impact on fish production as man-induced changes in vertical mixing caused by tidal power development. (Author's abstract)
W87-01822

MISSISSIPPI-ATCHAFALYA DIVERSION: A NEW PERSPECTIVE,
For primary bibliographic entry see Field 6B.
W87-01843

EFFICACY AND COST OF AQUATIC WEED CONTROL IN SMALL PONDS,
Florida Univ., Gainesville. Dept. of Fisheries and Aquaculture.
For primary bibliographic entry see Field 6C.
W87-01886

REGIONAL FREQUENCY ANALYSIS OF HYDROLOGIC MULTIYEAR DROUGHTS,
Kansas State Geological Survey, Lawrence.
For primary bibliographic entry see Field 2B.
W87-01922

USING LANDSAT DATA TO CLASSIFY LAND USE FOR ASSESSING THE BASINWIDE RUNOFF INDEX,
Florida Univ., Gainesville. Dept. of Agricultural Engineering.
D. A. Still, and S. F. Shih.
Water Resources Bulletin WARBAQ, Vol. 21, No.

6, p 931-940, December 1985. 3 fig, 5 tab, 11 ref. St. John's River Water Management District Contract DSR No. 81006cg-1.

Descriptors: *Runoff, *Remote sensing, *Land use, *Hydrologic aspects, Computer programs, Econlockhatchee River Basin, Florida, Osceola County, Orange County, Seminole County, St. John's River, Spectral analysis, Land use classification.

Remote sensing data in the form of Landsat computer compatible tapes (CCT) was used to determine land use and land cover as an aid in hydrologic studies that were used to estimate a basinwide runoff index in the Econlockhatchee (Econ) River Basin, located in the eastern central part of Florida. The Basin is approximately 680 sq km with land area in Osceola, Orange and Seminole counties. This area contributes to the south-north flow of the St. John's River. The Basin is composed primarily of swamps and wetlands. With the use of the General Electric Image 100 multispectral image progessing system in conjunction with the Earth Resources Laboratory Application Software (ELAS), CCT's on February 9, 1976, were analyzed by spectral differences to determine unique land use conditions within the Econ River Basin. The result showed that the Landsat data can be successfully used to monitor the USGS land use Level 1. An advantage of using the Landsat data for land use classification is that new data are periodically available for updating the land use information. The Soil Conservation Service curve number was used to establish a basinwide runoff index which includes a prime variable of land use changes with time. The basinwide runoff index in 1972 (with USGS 1972 Land Use maps) was similar to the one in 1976 (with Landsat data dated February 9, 1976). This implies that the runoff from the entire Econ Basin was not noticeably changed between 1972 and 1976. (Peters-PTT)
W87-01928

DESIGN AND IMPACT ANALYSIS FOR DIVERSION AT COAL CREEK MINE,
Utah Center for Water Resources Research, Logan.
D. S. Bowles, J. L. Grant, W. E. Humphries, and A. P. O'Hayre.
Water Resources Bulletin WARBAQ, Vol. 21, No. 6, p 995-1003, December 1985. 2 fig, 2 tab, 14 ref.

Descriptors: *Coal mines, *Reservoir design, *Erosion control, Diversion, Coal Creek, Campbell County, Wyoming, Field procedures, Diversion design, Impact evaluation, Channel stability, Detention basin.

A diversion stream was designed to carry the flow from East Fork of Coal Creek around the area proposed for mining at Thunder Basin Coal Company's (TBCC) Coal Creek mine in Campbell County, Wyoming. The field and anaylsis procedures necessary to prepare the diversion design and impact evaluation are described and the innovative concepts developed for the diversion system design to minimize impacts on downstream channel stability are presented. Under the proposed diversion system design, water from the East Basin of Coal Creek will be diverted at two locations. At one location, flow will be impounded by a small dam and decanted by a pump through a pipeline into East Fork at the location of the second diversion. At this location, a training dike will be placed across the stream channel to divert flows into a diversion channel. Gravity flow along the diversion channel will deliver water to a playa area which will be converted into a detention basin by placing a small dam across its southern end. Flows up to the magnitude of the 24-hour 2-year peak flow will be passed directly through the detention basin into Middle Fork with negligible attenuation of flow rates. For less frequent events, water will be stored in the detention basin in order to prevent velocities in Lower Middle Fork from exceeding the maximum permissible velocity above which scouring may occur. Evaporation and seepage losses from the diversion system were estimated to be small and should be more than offset by the addition of water from the playa drainage basin into the Coal Creek drainage. Velocities predicted for the Lower Middle Fork after the diversion is constructed are expected to be low enough that significant erosion of the channel is not expected to occur. (Author's abstract)
W87-01934

APPLICATION OF MATHEMATICAL PROGRAMMING IN PLANNING SURFACE WATER STORAGE,
Arizona Univ., Tucson. Dept. of Hydrology and Water Resources.
For primary bibliographic entry see Field 2E.
W87-01936

WATER DISTRIBUTION IN SICILY,
For primary bibliographic entry see Field 5F.
W87-02045

APPROACH TO PARAMETER ESTIMATION AND STOCHASTIC CONTROL IN WATER RESOURCES WITH AN APPLICATION TO RESERVOIR OPERATION,
California Univ., Davis. Dept. of Land, Air and Water Resources.
For primary bibliographic entry see Field 2E.
W87-02269

NONPARAMETRIC KERNEL ESTIMATION OF FLOOD FREQUENCIES,
Ottawa Univ. (Ontario). Dept. of Civil Engineering.
For primary bibliographic entry see Field 2E.
W87-02270

HURST BEHAVIOR OF SHIFTING LEVEL PROCESSES,
Colorado State Univ., Fort Collins. Dept. of Statistics.
R. Ballerini, and D. C. Boes.
Water Resources Research WRERAO, Vol. 21, No. 11, p 1642-1648, November 1985. 6 fig, 2 tab, 17 ref. NSF Grant CEE-8110782.

Descriptors: *Hurst behavior, *Stochastic process, Stochastic hydrology, Model studies, Mathematical equations, Estimating equations, Simulation analysis, Reservoirs.

The hypothesis that certain shifting level processes are dependent on and preserve the Hurst effect for the rescaled adjusted range is mathematically demonstrated. Although such processes belong to a stable domain of attraction, and not that of fractional Brownian motion, they do have asymptotic behavior of the rescaled adjusted range identical to that of fractional Brownian noise and are easily simulated. Other shifting level processes that belong to the same attraction domain preserve the Hurst effect for raw and adjusted ranges, but not for the rescaled adjusted range. The Hurst effect is defined in terms that may be related to inflow to a reservoir over a number of years. The concept of the Hurst effect may also be applied to such geophysical time series as rainfall or temperature atmospheric pressure. (Michael-PTT)
W87-02276

RESERVOIR MANAGEMENT AND OPERATIONS MODELS: A STATE-OF-THE-ART REVIEW,
California Univ., Los Angeles. Dept. of Civil Engineering.
For primary bibliographic entry see Field 6A.
W87-02296

OPTIMAL MULTIRESERVOIR NETWORK CONTROL BY THE DISCRETE MAXIMUM PRINCIPLE,
Dorsch Consult G.m.b.H., Munich (Germany, F.R.).
For primary bibliographic entry see Field 6A.
W87-02298

TESTING FLOOD FREQUENCY ESTIMATION METHODS USING A REGIONAL FLOOD GENERATION MODEL,
Washington Univ., Seattle. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2E.
W87-02306

FLOOD ESTIMATES: HOW GOOD ARE THEY,
Linsley, Kraeger Associates Ltd., Santa Cruz, CA.
For primary bibliographic entry see Field 2E.
W87-02324

COMPARISON OF ESTIMATED PROBABLE MAXIMUM FLOOD PEAKS WITH HISTORIC FLOODS,
Bureau of Reclamation, Denver, CO. Engineering and Research Center.
For primary bibliographic entry see Field 2E.
W87-02544

HYDRAULIC MODEL STUDIES OF FUSE PLUG EMBANKMENTS,
Bureau of Reclamation, Denver, CO. Engineering and Research Center.
For primary bibliographic entry see Field 8B.
W87-02546

4B. Groundwater Management

SIMPLIFIED ANALYSIS OF TWO-WELL TRACER TESTS IN STRATIFIED AQUIFERS,
Auburn Univ., AL. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2F.
W87-01877

PREDICTING IMPACTS FROM WATER CONSERVATION AND ENERGY DEVELOPMENT ON THE SALTON SEA, CALIFORNIA,
California Univ., Los Angeles. Office of Environmental Science and Engineering.
For primary bibliographic entry see Field 6G.
W87-01897

GEOLOGIC INFERENCE FROM 'FLOW NET' TRANSMISSIVITY DETERMINATION: THREE CASE STUDIES,
Battelle Pacific Northwest Labs., Richland, WA.
For primary bibliographic entry see Field 2F.
W87-01927

OPTIMAL STEADY-STATE IN GROUNDWATER MANAGEMENT,
California Univ., Riverside. Dept. of Soil Science and Agricultural Engineering.
K. C. Knapp, and E. Feinerman.
Water Resources Bulletin WARBAQ, Vol. 21, No. 6, p 967-975, December 1985. 3 fig, 3 tab, 21 ref.

Descriptors: *Groundwater management, *Optimization, *Economic aspects, Regulations, Withdrawals, Profits, User costs, Confined aquifers.

Groundwater use is likely to be inefficient in the absence of regulation and there is substantial interest in optimal groundwater withdrawals over time. Under an optimal regime withdrawals, pumping lifts, and profits converge to steady-state levels. The notion of an optimal steady-state in the context of groundwater management is investigated. It is shown that optimal steady-state lifts, withdrawals, and marginal user costs can be readily calculated for multi-cell models of confined aquifers. Applications to the design of economically efficient groundwater management policies are discussed, comparisons to previous work and to the safe yield concept are made, and an illustrative example is given. Although the main results of this paper are for confined aquifers, the concepts and methods may be even more useful for unconfined (water table) aquifers where the flow equations are nonlinear. (Peters-PTT)
W87-01931

GROUNDWATER MANAGEMENT INSTITUTIONS IN KANSAS,
Kansas Univ., Lawrence. School of Law.

For primary bibliographic entry see Field 6E.
W87-01950

CLOGGING OF RECHARGE WELLS BY SUSPENDED SOLIDS,
Agrar- und Hydrotechnik G.m.b.H., Essen (Germany, F.R.).
A. F. Bichara.
Journal of Irrigation and Drainage Engineering (ASCE) JIDEDH, Vol. 112, No. 3, p 210-224, August 1986. 8 fig, 3 tab, 12 ref.

Descriptors: *Clogging, *Recharge wells, *Groundwater recharge, *Recharge, *Wells, *Suspended solids, Artificial recharge, Filters, Aquifers.

Field conditions were reproduced in the laboratory to investigate the mechanism of clogging of recharge wells. Dosing with water of controlled quality and temperature, containing different types of added suspended solids of known size, with concentrations in the range 0.5-250 mg/L, was carried out in 45-degree segmental perspex models simulating confined aquifer conditions. Both filter-packed and nonfilter-packed wells were tested. It was found that the lower the concentration of the suspended solids in the recharge water, the greater the weight of solids required to clog the well. The filter pack has been clearly established as a major factor in controlling the clogging speed. The amount of suspended solids required to clog the simulated filter-packed well was 10-15 times the amount required to clog a similar nonfilter-packed well; on the other hand, doubling the filter-pack thickness results in almost doubling the time required to clog the well. The particle size distribution of the filter pack should be selected so as to remove the maximum amount of suspended solids from the recharge water before it reaches the aquifer face. (Doria-PTT)
W87-01951

SUBSURFACE DISPOSAL OF LIQUID LOW-LEVEL RADIOACTIVE WASTES AT OAK RIDGE, TENNESSEE,
Oak Ridge National Lab., TN.
For primary bibliographic entry see Field 5E.
W87-02053

STUDY OF CURRENT UNDERGROUND INJECTION CONTROL REGULATIONS AND PRACTICES IN ILLINOIS,
Illinois State Water Survey Div., Champaign.
For primary bibliographic entry see Field 5G.
W87-02055

CLASS I INJECTION WELL PERFORMANCE SURVEY,
Underground Injection Practices Council, Oklahoma City, OK.
For primary bibliographic entry see Field 5E.
W87-02057

INEXPENSIVE FLOW-THROUGH CELL AND MEASUREMENT SYSTEM FOR MONITORING SELECTED CHEMICAL PARAMETERS IN GROUND WATER,
Illinois State Water Survey Div., Champaign. Aquatic Chemistry Section.
For primary bibliographic entry see Field 7B.
W87-02059

LABORATORY STUDY OF ELECTROMIGRATION AS A POSSIBLE FIELD TECHNIQUE FOR THE REMOVAL OF CONTAMINANTS FROM GROUND WATER,
For primary bibliographic entry see Field 5G.
W87-02060

SUITABILITY OF POLYVINYL CHLORIDE WELL CASINGS FOR MONITORING MUNITIONS IN GROUND WATER,
Cold Regions Research and Engineering Lab., Hanover, NH.
For primary bibliographic entry see Field 5G.
W87-02061

WATER WELL INDUSTRY SUPPLIERS,
D. S. Hurlburt.
Water Well Journal, Vol. 40, No. 6, p 47-50, June 1986. 2 fig, 1 tab.

Descriptors: *Water wells, *Drilling, *Supplies, *Wells, *Services, Survey, Training.

Respondents to a recent Water Well Journal survey noted three main factors in their choice of a particular supply house: (1) an adequate variety of quality products; (2) the right services; and (3) a large inventory of in-stock items. Proximity to the driller's location was listed as an important factor by only 13% of the respondents. Sales people are another key factor in the success of a supply house because they link the customer to the products. Almost 60% of respondents expressed a desire for their suppliers to offer more educational seminars. Most drillers are satisfied with the range of services offered by their water wall supply houses. (Rochester-PTT)
W87-02073

WASHINGTON STATE'S REGULATION DILEMMA,
For primary bibliographic entry see Field 6E.
W87-02075

POLICY EVALUATION TOOL: MANAGEMENT OF A MULTIAQUIFER SYSTEM USING CONTROLLED STREAM RECHARGE,
Geological Survey, San Diego, CA.
For primary bibliographic entry see Field 6B.
W87-02287

OVERVIEW OF THE LAW OF GROUNDWATER MANAGEMENT,
Chicago-Kent Coll. of Law, IL.
For primary bibliographic entry see Field 6E.
W87-02289

ALTERNATIVES AND UNCERTAINTIES IN INTERSTATE GROUNDWATER LAW,
New Mexico Univ., Albuquerque.
For primary bibliographic entry see Field 6E.
W87-02290

HYDROTHERMAL EXPLOITATION OF GROUNDWATER BY WATER-WATER HEAT PUMP, (L'EXPLOITATION HYDROTHERMIQUE DES NAPPES PAR POMPE A CHALEUR EAU-EAU),
Bureau de Recherches Geologiques et Minieres, Orleans (France).
J. P. Sauty, and J. Y. Ausseur.
La Houille Blanche, No. 3/4, p 289-298, 1985. 9 fig, 3 tab, 12 ref.

Descriptors: *Groundwater management, *Heat pumps, *Heat transfer, *Geothermal resources, *Strasbourg, *Regulations, Energy sources, Thermal power, Legal aspects, Computer models.

When groundwater is used for heating or cooling by means of a heat pump, reinjection of the water via a second drill hole preserves the water resource but disturbs the temperatures of the geologic medium, which has consequences not only for the facility itself but also on other potential users downstream from the reject well. After a review of the trend in this new demand for groundwater (one estimate: 50,000 home-equivalents of heating in 1986 by such heat pumps) and the present state of regulation in France, an attempt is made to define means to evaluate the impact of these facilities on the reserves. Finally, The possibility of facilitating management of groundwater used for various purposes by means of hydrothermal management models is discussed. A program devised for Strasbourg is described briefly. (Airone-PTT)
W87-02422

HEAT PUMP ON GROUND WATER AND COMBINED SOLAR/GEOTHERMAL POWER. A PILOT OPERATION ON 224 DWELLINGS AT AULNAY-SOUS-BOIS, (POMPE A CHALEUR SUR NAPPE ET HELIOGEOTHERMIE. UNE OPERATION PILOTE SUR 224 LOGEMENTS A AULNAY-SUR-BOIS),
Ecole Nationale Superieure des Mines de Paris, Fontainebleau (France). Centre d'Information Geologique.
P. Iris.
La Houille Blanche, No. 3/4, p 299-305, 1985. 6 fig, 1 ref.

Descriptors: *Pilot plants, *Energy sources, *Heat pumps, *Aulnay-sur-Bois, *Paris, *Heat transfer, Evaluation, Geothermal resources, Groundwater.

A patented system, currently in use at Aulnay-sur-Bois, is designed to make use, via a heat pump, of groundwater reserves at not very great depths. In the locale in question, a sandy water basin of the lower Eocene epoch is located at a depth of 60 to 80 m and is at a temperature of 13 C. This is perfectly suited for the apartment buildings that cover the entire north area of Paris. The facility has been in operation for a year, and the first complete record is given, along with some general conclusions. (Airone-PTT)
W87-02423

INTERSEASONAL HEAT STORAGE IN AN AQUIFER AT MEDIUM DEPTH. (STOCKAGE DE CHALEUR INTERSAISONNIER EN AQUIFERE A MOYENNE PROFONDEUR),
Bureau de Recherches Geologiques et Minieres, Orleans (France).
A. Boisdet.
La Houille Blanche, No. 3/4, p 307-312, 1985. 7 fig, 14 ref.

Descriptors: *Mathematical models, *Heat transfer, *Heat storage, *Aquifer, *Geothermal resources, Energy sources, Energy storage, Costs, France, Alabama.

The main characteristics of heat storage operations in an aquifer, conducted in the recent past (Bonneaud, Campuget in France and Mobile in the U.S.A.), are reviewed. Projects being carried out or are under study are analyzed (ELF-CEA in Plaisir, University of Minnesota in Saint Paul, Institut Mixte de Recherches Geothermiques: IMRG). The project in development at the IMRG is interseasonal heat storage in an aquifer at medium depth. The stage of development of the project is described from an energy and an economic standpoint. This project, which exhibits considerable synergy with doublet geothermal operations, should lead rapidly to full-scale implementation. (Author's abstract)
W87-02424

STORAGE IN A DEEP AQUIFER AT HIGH TEMPERATURE. PILOT PLANT IN PLAISIR, (STOCKAGE EN NAPPE PROFONDE A HAUTE TEMPERATURE. PILOTE DE PLAISIR),
CEA Centre d'Etudes Nucleaires de Saclay, Gif-sur-Yvette (France).
J. Despois.
La Houille Blanche, No. 3/4, p 313-318, 1985. 3 fig.

Descriptors: *Pilot plants, *Geothermal resources, *Heat storage, *Plaisir, *France, Water table, Incineration, Heat transfer.

Underground heat storage, along with the heat source and its use, form an indissociable system which must be optimized. This imposes constraints on the size and the storage temperature and thereby on the selection of the water table. For each size there is an optimal injection temperature, usually well above 100 C. One can expect recovery of approximately 60 percent of the stored heat for use on conventional distribution systems. The related engineering problems appear to be solved. The construction of a pilot storage facility coupled with a garbage incineration plant processing 120,000 metric tons per year and a system serving more than 5,000 dwellings has been started in

Plaisir, near Versailles. First significant results will probably be available in 1988. (Author's abstract)
W87-02425

HEAT STORAGE IN SURFACE WATER. THE PILOT PLANTS OF MONTREUIL AND LYON GERLAND, (STOCKAGE DE CHALEUR EN NAPPE DE SURFACE. LES PILOTES DE MONTREUIL ET DE LYON-GERLAND),
Bureau de Recherches Geologiques et Minieres, Orleans (France).
J. M. Lejeune.
La Houille Blanche, No. 3/4, p 319-324, 1985. 4 fig.

Descriptors: *Pilot plants, *Heat storage, *Alluvial aquifers, *Groundwater management, *France, *Geothermal resources, *Montreuil, *Lyon-Gerland, *Heat transfer, Aquifers, Wells, Flow rates, Groundwater.

Two main types of storage were analyzed by the B.R.G.M. depending on whether or not groundwater circulation existed at the site. In Montreuil a doublet system collecting the Ypres aquifer operates according to the hot well - cold well system and allows heating and cooling of 53,000 sq m of office space. After two years of operation, the record is very satisfactory. At Lyon-Gerland, interseasonal storage of summer calories for urban heating is being planned for 1987. The plan proposes use of the alluvial groundwaters and novel construction of a circular molded wall (this last made necessary by the high flow rate of the aquifer). (Author's abstract)
W87-02426

PROJECT FOR INTERSEASONAL STORAGE OF CLIMATIC CALORIES IN AN AQUIFER, (PROJET DE STOCKAGE INTERSAISONNIER DE CALORIES CLIMATIQUES EN AQUIFERE),
BURGEAP S.A., Paris (France).
E. Landon, and J. P. Petit.
La Houille Blanche, No. 3/4, p 325-327, 1985. 3 fig.

Descriptors: *Solar energy, *Geothermal resources, *Heat storage, *Energy sources, *Heat transfer, Economic aspects, Groundwater, Aquifers, Heat pumps, Cost repayment.

A plan for a system of solar heating associated with storage in an aquifer, which was completed in 1982, was modified to take into account later developments in the energy and economic contexts. Modifications include addition of two heat pumps, and use of a smaller solar conductor surface area - 275 sq m as opposed to 500. These modifications result in a drop in surcosts, and a consequent shortening (to 12.5 years after construction from 22) of the time needed to recoup the costs. (Airone-PTT)
W87-02427

SECOND ANNUAL EASTERN REGIONAL GROUND WATER CONFERENCE.
National Water Well Association, Worthington, OH.
For primary bibliographic entry see Field 2F.
W87-02437

LOCATING AND EVALUATING POTABLE WATER SUPPLIES IN AN EXTENSIVELY MINED AREA: A CASE HISTORY,
SRW Associates, Inc., Pittsburgh, PA.
J. M. Roberts, and J. G. Mendicino.
IN: The Second Annual Eastern Regional Ground Water Conference, July 16-18, 1985, Portland, Maine. 1985. p 212-227, 5 fig, 3 tab, 1 ref.

Descriptors: *Potable water, *Groundwater, *Water supply development, *Mining, Case studies, Aquifer evaluation, Wells, Drilling, Pumps, Well water, Test wells.

Based on the results of well drilling, pump tests and groundwater sampling programs, drill sites TH-1 and TH-2 (in Armstrong County, Pennsylvania) were estimated to be suitable sites for the installation of production wells. As a result, recommendations were presented to County and Township officials concerning the design and installation of production wells at each of the two drill sites. The recommendations were presented with the intent of providing optimum yield and water quality and included specifications for the installation of casing, well grouting, and pump replacement. The drill site TH-1 was suggested as the primary production well to be utilized due to its slightly better water quality, while TH-2 was recommended as a backup production well in the event of mechanical breakdown, insufficient production, contamination, etc. at TH-1. It was also recommended that an automatic shutoff system be installed in each production well which would prohibit drawdown from dropping below the elevation of the Lower Freeport Coal, and which would prevent drawdown depths that might create hydraulic gradients which would enable groundwater to flow into the wells from the reported mine pools at elev. 1130, just east and southeast of the site. Though the final pumping rate and frequency were to be dependent on the final design of the well pump and distribution system by the designing engineers, it was recommended that the system provide for a long-term consumption rate of 100 gallons/minute while limiting the final pumping rate to 150 gallons/minute. (See also W87-02437) (Lantz-PTT)
W87-02452

GROUNDWATER DEVELOPMENT AND MANAGEMENT PLANNING FOR THE COASTAL PLAIN OF NEW JERSEY,
Camp, Dresser and McKee, Inc., Boston, MA.
D. C. Noonan, and J. M. Henderson.
IN: The Second Annual Eastern Regional Ground Water Conference, July 16-18, 1985, Portland, Maine. 1985. p 299-319, 6 fig, 1 tab, 5 ref.

Descriptors: *Groundwater development, *Management planning, *Coastal plains, *New Jersey, Water supply development, Camden, Groundwater mining, Water demand, Piezometers, Water resources development, Groundwater management.

By nature of the very seriousness of its problems, the State of New Jersey has been forced to take powerful and decisive action to protect its water resources. Recognizing that overpumping in the confined portions of the Potomac-Raritan-Magothy formation (PRM), in the Camden metropolitan area, threatens the future of the resource as a water supply, the New Jersey Department of Environmental Protection (NJDEP) is using its recently enacted General Management Regulations to effect changes in groundwater withdrawals in the region. Specifically, the NJDEP intends to establish a critical area that roughly parallels the minus-fifty-feet-below-sea level piezometric contour, and enforce up to 50% cutbacks in production in this critical area. Alternative water sources will be evaluated to make up for the production that is cut back, as well as for new demands in the future. Ample water supplies are available in the outcrops of the PRM (200 to 220 mgd), the Mount Laurel Wenonah Aquifer (15 to 20 mgd), and the Cohansey Sand Aquifer (50 to 20 mgd). Whatever the new source that is eventually developed, the State of New Jersey (and the NJDEP in particular) are moving swiftly and effectively to avert a potentially disastrous situation, and provide adequate, clean water for the 755,000 residents of the Camden Metro Area for many years into the future. (See also W87-02437) (Lantz-PTT)
W87-02458

RECENT ASSESSMENT OF THE HYDROGEOLOGY AND GROUNDWATER AVAILABILITY OF THE NORTHERN NEW JERSEY COASTAL PLAIN AQUIFERS,
Jordan (Edward C.) Co., Inc., Portland, ME.
For primary bibliographic entry see Field 2F.
W87-02459

EVALUATION OF GROUND WATER WELL SUPPLIES IN COASTAL NEW HAMPSHIRE BY UTILIZING SURFACE PIEZOMETRIC INFORMATION,
New Hampshire Univ., Durham.
T. P. Ballestero.
IN: The Second Annual Eastern Regional Ground Water Conference, July 16-18, 1985, Portland, Maine. 1985. p 340-347, 1 fig, 4 ref.

Descriptors: *Groundwater potential, *Well water, *New Hampshire, *Coastal aquifers, *Piezometers, Water supply development, Groundwater management, Groundwater budget, Weirs, Hydraulic characteristics, Groundwater recharge.

A method is proposed for estimating groundwater supplies in coastal environments by using piezometric maps of test pit data, and from the use of miniature piezometers. Site evaluation was performed adjacent to the Great Bay in New Hampshire, which realizes significant tidal fluctuations and saltwater intrusion. An example aquifer evaluation is given where it was required to identify (a) the availability of groundwater and (b) the potential for saltwater intrusion. Initial aquifer evaluation was performed by mapping the piezometric surface utilizing information from test pits. This information enables the identification of aquifer hydraulic characteristics. Next, miniature piezometers were placed in groundwater fed streams. In addition, small V-notched weirs were used to strengthen the miniature piezometer data base. Qualitative and quantitative analysis of this data provided information on potential well yields, aquifer hydraulic characteristics, aquifer response to recharge and potential for saltwater intrusion. In the presented example, the surface information is evaluated and then compared to a traditional pump test analysis. A 48-hour pump test verified the predictions of the preliminary analyses which were based on surface hydrogeologic information. Further, the pump test verified assumptions concerning leakage and aquifer response to recharge. The methodology provides an inexpensive screening tool for evaluating potential groundwater resources development in coastal areas. (See also W87-02437) (Lantz-PTT)
W87-02460

MANAGING GROUND WATER SUPPLIES IN A SOLE SOURCE AQUIFER,
S E A Consultants, Inc., Boston, MA.
J. M. Jammallo, and A. J. Zuena.
IN: The Second Annual Eastern Regional Ground Water Conference, July 16-18, 1985, Portland, Maine. 1985. p 545-556, 5 ref.

Descriptors: *Groundwater management, *Aquifers, *Water supply development, Barnstable, Massachusetts, Pumping, Groundwater budget, Groundwater quality, Models, Flow profiles, Water demand, Water supply.

The results of the groundwater and water resource protection plan recently completed for the Town of Barnstable, Massachusetts indicated that the present pumping capacity of the public supply wells of 23.74 mgd will not meet the projected saturation development density, peak water demand of 32.11 mgd. Planned future water supplies combined with the present capacity, however, will be adequate to meet these demands. Future pumping and recharge conditions may sufficiently modify the groundwater flow regime to facilitate contaminant transport which would otherwise not be expected under present conditions. The quality of these supplies, therefore may be threatened based on a variety of contaminant sources within delineated recharge areas defined as zones of contribution. Well protection land areas often may be defined based on an arbitrarily determined set of criteria such as cultural landmarks which are unrelated to technical groundwater issues. This protection plan incorporated a three-dimensional, finite-difference groundwater flow model to simulate flow under a variety of pumping and recharge conditions. Zones of contribution were developed utilizing the flow model to define specific land areas around public supply wells which provide long-term recharge to these existing and potential sources. These zones of contribution were then used as the basis for determining the potential for contamination of the supply wells within the zones. Exploration for future water supplies to meet in-

cressing demands must take into consideration the possibility of salt water intrusion from immediately adjacent coastal systems including the Hyannis Water Pollution Control Facility and numerous individual septic systems. (See also W87-02437) (Lantz-PTT)
W87-02474

GROUND WATER MANAGEMENT PLAN FOR PROTECTION OF A SHALLOW AQUIFER AT THE NAVAL WEAPONS CENTER, CHINA LAKE, CALIFORNIA,
Montgomery (James M.), Inc., Pasadena, CA.
For primary bibliographic entry see Field 5G.
W87-02537

4C. Effects On Water Of Man's Non-Water Activities

RATES OF LANDSLIDING AS IMPACTED BY TIMBER MANAGEMENT ACTIVITIES IN NORTHWESTERN CALIFORNIA,
San Jose State Univ., CA. Dept. of Geology.
M. D. Wolfe, and J. W. Williams.
Bulletin of the Association of Engineering Geologists, Vol. 23, No. 1, p 53-60, February 1986. 6 fig, 11 tab, 1 ref.

Descriptors: *Forest management, *Landslides, *Engineering geology, Road construction, *California, Watersheds, Rock Creek, Topographic mapping, Forest hydrology.

The impacts on the rates of landsliding by forest management activities (road construction and timber harvesting) in northwestern California are evaluated. The effects of these land disturbing activities were studied for various geomorphic zones of a watershed, valley inner gorges, land with slopes greater than 80 percent, and 'other' watershed lands. An analysis of historical aerial photography and computer generated digital terrain slope maps was used to determine changes, over time, in the distribution of active landslides in third order watersheds, where the present watershed conditions vary from pristine to highly disturbed. In all of the disturbed watersheds, forest management activities increased the landslide rates (landslides per square mile) of each geomorphic zone. The valley inner gorges, and land with slopes greater than 80 percent had the greatest landslide rate increases. Managed valley inner gorges and managed slopes greater than 80 percent had 11 to 26 and 3 to 26 times more landslides per square mile than managed 'other lands', respectively. These data suggest that the valley inner gorges and land with slopes greater than 80 percent are the most landslide prone geomorphic zones in a watershed, and the most sensitive to forest management activities. (Author's abstract)
W87-01844

EFFECTS OF DEICING SALTS ON WATER CHEMISTRY IN PINHOOK BOG, INDIANA,
Indiana Dunes National Lakeshore, Porter, IN.
For primary bibliographic entry see Field 5B.
W87-01888

ACCUMULATION OF SELECTED TRACE METALS IN SOILS OF URBAN RUNOFF SWALE DRAINS,
Corvallis Environmental Research Lab., OR.
P. J. Wigington, C. W. Randall, and T. J. Grizzard.
Water Resources Bulletin WARBAQ, Vol. 22, No. 1, p 73-79, February 1986. 4 fig, 6 tab, 19 ref.

Descriptors: *Urban runoff, *Water pollution sources, *Trace metals, *Storm runoff, *Drains, *Swale drains, Washington, Cadmium, Copper, Lead, Zinc, Soils, Highways, Metal concentrations.

Field investigations were conducted at three sites in the Washington, D.C. area to detect the accumulation patterns of the trace metals, cadmium, copper, lead, and zinc in the soils of roadside grassed swale drains that had been receiving urban stormwater runoff. Two sites were residential areas and one site was an intensively used highway. The research results indicate that the use of swale drains to control urban stormwater runoff had few harmful effects to fine textured soils with respect to the study metals. With the exception of zinc, typical roadside patterns of decreasing metal concentrations with increasing distance from roads were observed for the upper 5 cm of study soils. Zinc accumulated in residential grassed swales due to leachate from galvanized culverts. Sampling to a depth of 60 cm revealed no evidence of subsurface trace metal enrichment in the study swales. Although the percentage of soil zinc in leachable form was as high as 20 percent of total zinc concentrations, the other study metals had small leachable components. Leachable lead was always less than 1 percent of the total lead. (Author's abstract)
W87-01890

FOG DRIP, WATER YIELD, AND TIMBER HARVESTING IN THE BULL RUN MUNICIPAL WATERSHED, OREGON,
Portland Bureau of Water Works, Sandy, OR. Sandy River Station.
J. B. Ingwersen.
Water Resources Bulletin WARBAQ, Vol. 21, No. 3, p 469-473, June 1985. 6 fig, 1 tab, 8 ref.

Descriptors: *Fog, *Forest management, *Water yield, *Fog drip hypothesis, Bull Run Watershed, Portland, Oregon, U.S. Forest Service, Fog interception, Stream flow data.

In order to evaluate the effects of timber harvesting on the water resource in the Bull Run Watershed, the U.S. Forest Service and the City of Portland, Oregon, entered into a cooperative study in 1955. Between 1969 and 1971, prescribed timber harvesting was conducted in two of the watersheds. Analysis of summer streamflow data indicates significant decreases at one of the watersheds (WS1) following logging of clearcut patches totaling 25 percent of each watershed's area. Previous research associated with timber harvesting and water yield in the Northwest suggest increases should be expected. Summer low flows are of particular importance in most municipal watersheds because of high water demand and storage depletion during the summer months. The reduction in fog interception and drip has been hypothesized as a possible cause of the decrease in summer flows. New analyses are presented and an extension of the fog drip hypothesis is presented as a way to explain the results of recent data analysis. Analysis of the streamflow data indicates a significant recovery from the impacts on summer water yield due to a loss of fog drip upon timber harvesting. Measurable impacts and their associated recovery are notable only during the months of June and July. Recovery begins about five or six years following harvest, possibly due to renewed fog drip from prolific revegetation. Watershed positioning with respect to prevailing weather systems and the extent of burning or removal of slash and residual vegetation during logging appear to be important factors in predicting the impact of fog drip, the expected increase in yield due to decreased evapotranspiration can be observed. Redistribution of fog drip may be a major factor in the measurements of local interception and water yield. (Peters-PTT)
W87-01920

LONG-TERM PATTERNS OF WATER QUALITY IN A MANAGED WATERSHED IN OREGON: 1. SUSPENDED SEDIMENT,
Weyerhaeuser Co., Tacoma, WA. Environmental Sciences and Technology Dept.
K. Sullivan.
Water Resources Bulletin WARBAQ, Vol. 21, No. 6, p 977-987, December 1985. 7 fig, 2 tab, 22 ref.

Descriptors: *Water quality, *Forest management, Suspended load, *Suspended sediments, Oregon, Roads, Turbidity, Hydrologic stations, Middle Santiam River, Cascades, Watersheds, Sediments, Erosion.

The cumulative effects of forest management activities on water quality at a downstream point were monitored from 1972-1980 during development of a watershed for timber resources in Western Oregon. The water quality data covered the commerical development of 8000 ha of forest land, including the construction of an extensive road network and the conversion of a large area of old-growth forest to plantations. Suspended sediment concentration and turbidity were measured at two hydrologic stations which bracketed a 10-km reach of the Middle Santiam River in the Western Cascades of Oregon as it flowed through an 8000-ha block of intensively managed forest land. Slope failures often accompany road building and harvesting in steep forested watersheds and pose the most serious threat to water quality. Although 180 km of road were constructed and 3400 ha of old-growth forests were harvested from slopes averaging over 60 percent, long-term changes in sediment yields remained undetectable during the period of measurement. The geologic characteristics of the basin and the road construction and maintenance techniques as prescribed by Oregon's forest practice regulations helped to minimize the occurrence of slope failures so that long-term changes in suspended sediment export rates did not occur. Throughout the nine-year measurement period, seven slope failures which added sediment directly to streams produced measurable short-term responses at the downstream sampling location, but these erosion events were too small and too infrequent to produce long-term changes in sediment yield from the watershed. (Peters-PTT)
W87-01932

BEDROCK CONTROLS ON STREAM CHANNEL ENLARGEMENT WITH URBANIZATION, NORTH CENTRAL TEXAS,
Baylor Univ., Waco, TX. Dept. of Geology.
For primary bibliographic entry see Field 2J.
W87-01939

HIGH BASIN OF THE OUANNE: CONSEQUENCES OF TRANSFORMATIONS OF THE FARMLAND ON THE WATER STORAGE CAPACITY OF THE SOIL, (LE HAUT BASSIN DE L'OUANNE: CONSEQUENCES DES TRANSFORMATIONS DU PAYSAGE AGRAIRE SUR LA CAPACITE DE STOCKAGE DE L'EAU DANS LES SOLS),
O. Baumann.
La Houille Blanche, Vol. 85, No. 2, p 153-159, 1985. 7 fig, 5 tab, 4 ref.

Descriptors: *Ouanne basin, *Soil water storage capacity, *Surface water, *Agriculture, *Soils, Hydrology, France, Soil zonation, Quantitative analysis.

This study was designed to determine quantitatively the different aspects of the response of the Ouanne basin (France) to changes in surface water flow resulting from changes in agriculture. The methodology devised for this study and the results of its application are described here. The approach included quantification of changes in agriculture from 1955 to 1980, definition of hydrologic compartments of the soil, study of anthropogenic factors capable of changing the hydrologic characteristics of the soils, quantitative analysis of modifications in soil water storage capacity in relation to anthropogenic variables, and estimation of the effects of changes in agricultural practice on soil water storage capacity, with mapping of the results. Estimation of the volumes of water retained in 1955 versus 1978 are presented according to different soil zones. (Rochester-PTT)
W87-01971

PROPERTIES, CLASSIFICATION, AND INTERPRETATIONS OF MINESOILS AT TWO SITES IN WEST VIRGINIA,
West Virginia Univ., Morgantown. Div. of Plant and Soil Sciences.
For primary bibliographic entry see Field 2G.
W87-01994

TILLAGE EFFECTS ON SOIL WATER RETENTION AND PORE SIZE DISTRIBUTION OF TWO MOLLISOLS,
Maryland Univ., College Park. Dept. of Agronomy.
R. L. Hill, R. Horton, and R. M. Cruse.
Soil Science Society of America Journal SSSJD4, Vol. 49, No. 5, p 1264-1270, September-October 1985. 6 fig, 4 tab, 22 ref.

Descriptors: *Tillage, *Soil water, *Water retention, *Pore size, *Mollisol, Capillary water, Density, Soil conservation, Model studies.

A study was conducted to determine the effects of conservation and conventional tillage on soil water retention and pore size distribution of two mollisols. Two locations were used. One location, site 1, was in its 2nd year of tillage experimentation on a Canisteo series soil and the other location, site 2, was in its 8th year on a Nicollet series soil. Undisturbed soil cores were obtained near the planted row. Soil water retention of the soil cores was measured at water matric potentials of 0 to -39.22 kPa. Pore size distribution was estimated by using a capillary model. Statistical differences in soil water retention due to tillage treatments appeared at site 1, with general means comparisons of reduced tillage > no tillage > conventional tillage in the amount of water retained at any matric potential. Reduced tilled soil generally retained a significantly (last significan difference 0.05) larger quantity of water than conventionally tilled soil. No-tilled soil was not significantly different from reduced tilled or conventionally tilled soil in its water retention characteristics. Soil under conventional tillage had a larger proportion of its pore volume in pores > 15 micrometer radii, compared with soils under conservation tillage which appeared to have a larger portion of pores in the 15 to 0.1 micrometer pore radius interval. The data indicated that bulk density increases occurred at the expense of larger pores. Conventionally tilled soils had a larger proportion of large pores and seemed more susceptible to densification than the soils under the conservation tillage systems. (Khumbatta-PTT)
W87-02040

INFLUENCE OF HABITAT MANIPULATIONS ON INTERACTIONS BETWEEN CUTTHROAT TROUT AND INVERTEBRATE DRIFT,
Maryland Univ., Frostburg. Appalachian Environmental Lab.
For primary bibliographic entry see Field 2H.
W87-02102

URBAN HYDROMETEOROLOGY REVIEW,
Illinois State Water Survey Div., Champaign. Climatology and Meteorology Section.
For primary bibliographic entry see Field 2B.
W87-02110

REMOVAL OF HIGHWAY CONTAMINANTS BY ROADSIDE SWALES,
For primary bibliographic entry see Field 5G.
W87-02184

MICROBIOLOGICAL PROBLEMS IN THE OFFSHORE OIL AND GAS INDUSTRIES,
Heriot-Watt Univ., Edinburgh (Scotland). Dept. of Brewing and Biological Sciences.
N. S. Battersby, D. J. Stewart, and A. P. Sharma.
Journal of Applied Bacteriology (Symposium Supplement) JABAA4, p 227S-235S, 1985. 2 fig, 53 ref.

Descriptors: *Offshore platforms, *Sulfur bacteria, Microbiological studies, Bacterial analysis, Biocides, Glycocalyx, Mutation, Resistance.

The problems posed by the growth, activity and control of sulfur-reducing bacteria (SRB) present in the waters around offshore drilling platforms are described. SRB nutritional requirements, distribution patterns and alternative methods for controlling SRB growth are examined. The effectiveness of using biocides to control SRB growth is evaluated in relation to problems associated with biocide treatment, including SRB entrapment within the glycocalyx and development of biocide-resistant mutants. It is concluded that further microbiological studies are needed to develop effective SRB control strategies. (Michael-PTT)
W87-02221

EFFECT OF TIMBER HARVEST ON THE FOOL CREEK WATERSHED, 30 YEARS LATER,
Rocky Mountain Forest and Range Experiment Station, Fort Collins, CO.
C. A. Troendle, and R. M. King.
Water Resources Research WRERAQ, Vol. 21, No. 12, p 1915-1922, December 1985. 4 fig, 3 tab, 19 ref.

Descriptors: *Logging, *Watershed management, Forest management, History, Flow measurement, Flow characteristics, Precipitation, Fraser Experimental Forest, Flood peak, Snowpack, Snowmelt.

A watershed at the Fraser Experimental Forest, Colorado was harvested using alternating clearcut and forested strips in 1956. Using 30 years of postharvest data, the impact of foresting operations on watershed hydrology can be evaluated. Average peak water equivalent over the entire watershed has been increased in addition to depositional increases in the snowpack in the openings. Long term climatic records show a strong correlation between estimated increases in flow and winter and melt period precipitation. The annual variability in increased flow, previously attributed to regrowth or time is now explained by precipitation. Peak discharges have also been increased with the largest effect occurring in the wettest years. Increases in peak water equivalent, annual flow and peak flow occurrence date all appear to be returning to preharvest levels at a very slow rate. (Michael-PTT)
W87-02307

EFFECTS OF SUBURBAN DEVELOPMENT ON THE GROUNDWATER OF THE STOCKTON FORMATION BUCKINGHAM TOWNSHIP, BUCKS COUNTY, PENNSYLVANIA,
Woodward-Clyde Consultants, Plymouth Meeting, PA.
M. N. Gallagher, and J. K. Adams.
IN: The Second Annual Eastern Regional Ground Water Conference, July 16-18, 1985, Portland, Maine. 1985. p 102-122, 8 fig, 4 tab, 28 ref.

Descriptors: *Groundwater pollution, *Water pollution sources, *Pennsylvania, Water sampling, Chemical analysis, Chemistry of precipitation, Calcium, Sodium, Chlorine, Bicarbonates, Nitrates, Regression analysis, Statistical studies, Mathematical studies, Feldspar, Halite, Domestic wastes.

Buckingham Township is located in Bucks County, north of the populated suburbs of Philadelphia. Development pressures are primarily housing developments which are serviced by onsite septic systems. During the period from 1978 to 1979, 118 groundwater, stream, spring, and precipitation water samples were collected. Water samples were analyzed for Ca, Mg, Na, K, Cl, SO4, HCO3, NO3, PO4, and SIO2. Samples were collected from random locations to characterize the water quality of the Stockton Formation aquifer and from specific locations to determine the seasonal variance in water quality. The principal cations were Ca and Na and the principal anions were HCO3 and Cl. Cultural activities in the area underlain by the Stockton Formation were found to affect the concentration of Cl, Na, and NO3. Water quality degradation was minimal, except in areas of point-source pollution associated with septic system failures. Thirty-eight percent of the wells sampled had NO3 concentrations less than 5 ppm, and 7% exceed 45 ppm. The mean NO3 concentration in stream groundwater and precipitation was 12.2 and 12.9 and 1.4 ppm respectively. The high percentage of groundwater samples with NO3 concentrations less than 5 ppm indicate that groundwater has not been adversely affected by present land use and impacted areas tend to be point-source problems. The average Cl concentrations for groundwater, stream water, and precipitation was 13.0, 9.9 and 2.4 ppm, respectively. Regression analyses and Na:Cl ratios indicate that halite and Na-Feldspar weathering are the principal sources of Na and Cl. Mass balance calculations of Cl for the Stockton Formation aquifer indicate an approximate loading of 1 times 10 to the 8th grams/yr in the study area. The principal sources of Cl were identified as precipitation, road salt, and domestic sewage. (See also W87-02437) (Author's abstract)
W87-02444

EFFECTIVENESS OF HIGHWAY DRAINAGE SYSTEMS IN PREVENTING SALT CONTAMINATION OF GROUND WATER,
Massachusetts Dept. of Public Works, Wellesley Hills. Research and Materials Section.
S. J. Pollock, and L. C. Stevens.
IN: Proceedings of the Fifth National Symposium and Exposition on Aquifer Restoration and Ground Water Monitoring, May 21-24, 1985, The Fawcett Center, Columbus, Ohio. 1985. p 709-733, 10 fig, 1 tab, 7 ref.

Descriptors: *Highway effects, *Drainage systems, *Salt, *Groundwater pollution, *Water pollution sources, Path of pollutants, Massachusetts, Water pollution effects.

The U.S. Geological Survey and the Massachusetts Department of Public Works are cooperatively conducting a study to determine the relative effectiveness of four different types of highway drainage systems in preventing highway deicing salt from getting into groundwater adjacent to highways. Sites representative of open drainage, closed drainage, closed drainage with one snow berm and closed drainage with full snow berms have been selected on State Route 25 in southeastern Massachusetts. Monitoring well networks have been designed such that water samples from these wells can be analyzed to determine the quantity of salt in the groundwater at each of the test sites. Salt loads in the drainage systems will be calculated from flow and specific conductance with the use of stage-to-discharge and conductance-to-concentrations rating curves. A comparison of the salt applied to the highway at each test site will be made with the salt leaving the highway from the drainage system outlets and the salt in the groundwater at each test site. Data collection will begin prior to the opening of the highway and continue until the highway has been open for 5 years. Cost benefit analysis for the different types of drainage systems will be determined. (See also W87-02497) (Author's abstract)
W87-02541

POLLUTION CONTROL AND CONSERVATION.
For primary bibliographic entry see Field 5C.
W87-02553

SOIL DESTRUCTION AND SOIL POLLUTION,
For primary bibliographic entry see Field 5B.
W87-02557

EFFECTS OF URBANIZATION ON LANDSCAPE ELEMENTS AND WOODLAND COVER,
M. Mocsenyi.
IN: Pollution Control and Conservation, Ellis Horwood Ltd., Chichester, England, 1985. p 267-285.

Descriptors: *Urbanization, *Environmental effects, Planning, Plant population, Ecological effects, Solar radiation, Evaporation, Transportation, Water pollution control, Parks, Forests.

In the course of their interactions, during millions of years, solar energy, water, vegetation and soil have created a state of equilibrium. Any disturbance done to it may have fatal consequences. The ability of plants to modify the micro- and local climate depends mainly on the extent to which they can affect the energy-economy of their own as well as that of their environment. Within the plant cover or microclimatic modifications having

an effect on layers nearest to the soil, these soil layers can exert their 'remote-effect' only in those cases, where they are capable of modifying significantly the characteristic phenomena of their natural habitat. The daily and seasonal fluctuation of the energy of solar radiation would make plant life impossible except only on a little part of dry-land, if water by its high specific heat and especially by the uptake of energy required for transpiration, did not reduce the intermolecular agitation within the body of the plant. By the evaporation of a 5 mm high water column, which corresponds the evaporation of 5 L water/sq m, nearly 3,000 kcal thermal energy becomes latent heat. This is as much as the thermal value of 1 kg of browncoal and would be sufficient to heat 1 sq m of glasshouse daily, in winter, in spite of the fact that the efficiency of heating installations is very small. Large towns change almost all climatic factors characteristic and determinant of their area prior to their establishment and they spoil not only the local natural climate of their territory, but they also exert harmful effects on areas lying on their permanent lee side, frequently within the range of 30-50 km. At present, in the urban area of large towns almost every square meter of area is covered by either building or solid cover. As a consequence of this, 60-90% of rain water falling on this area is conducted outside the town through the sewage system. Because of the fragile condition of the biosphere, town planning needs to consider the technical equipments and technological methods for the elimination and neutralization of pollutants, as well as the significance of woodland cover, parks and gardens. (See also W87-02553) (Lantz-PTT)
W87-02558

ROLE OF FORESTS IN ENVIRONMENTAL PROTECTION,
L. Madas.
IN: Pollution Control and Conservation, Ellis Horwood Ltd., Chichester, England, 1985. p 286-307, 1 fig, 2 tab, 17 ref.

Descriptors: *Forests, *Environmental protection, Trees, Plants, Erosion, Surface runoff, Letter, Soil conservation, Agricultural runoff, Air pollution, Recreation.

The forest itself is a life community (biocoenosis, ecosystem), which consists of interdependent elements: trees, shrubs and plants (phytocoenosis) and animals (zoocoenosis) and which directly influences its environment and also the climate and soil (biogeocoenosis). Taking into account the presence of man in the life of the forest, it can be considered an ecological system (ecosystem). The equilibrium of the life community (biocoenosis) can be sustained only at the price of constant changes - opposing forces and their resolution - therefore, it can be called a dynamic state of equilibrium. As the forest is one of the characteristics components of the landscape, its external changes have an influence on the entire landscape. The renewing of the forest - when the old tree-stock is replaced by young ones - in most cases creates a critical situation. On such occasions the familiar landscape also changes - in general sharp, linear walls emerge which are even accentuated by the shade-effect. Years will pass until a new biological community evolves to the same extent. When analyzing the water balance, particular attention should be paid to the impact of the forest on the surface run-off. Forests build up litter, which is of great importance for the water regime. The network of roots contributes to the formation and maintenance of favorable soil conditions. The decaying litter mingles with the mineral soil particles; by means of the root-textures the soil becomes loose and porous; the falling precipitation can more readily penetrate into it. Owing to this, in the forest in comparison with treeless areas the fluctuation of surface run-off is greatly reduced. It is especially evident at the time of showers and melting snow, when the quantity of water is more evenly distributed when entering the rivers. By considerably decreasing the maxima of surface run-off, forests reduce the danger of floods or reduce the rise in water level to a large extent. Afforestation serving the soil protection of sloping agricultural land is also based upon the great water-holding capacity of the forest soil: the afforestation of watersheds and ridges, as well as the planting of soil-protecting forest-belts along the contour lines. Forests also play a major role in: the reduction of deflation, reduction of air pollution; and reduction of noise damage. Forests also serve a major function in providing areas for recreation. (See also W87-02553) (Lantz-PTT)
W87-02559

4D. Watershed Protection

EROSION-SEDIMENTATION IN A CLOSED DRAINAGE BASIN IN NORTHWEST INDIANA,
National Soil Erosion Lab., West Lafayette, IN.
L. D. Norton.
Soil Science Society of America Journal SSSJD4, Vol. 50, No. 1, p 209-213, January-February 1986. 7 fig, 1 tab, 20 ref.

Descriptors: *Erosion, *Sedimentation, *Soil loss, *Closed basins, *Cultivation, *Indiana, Loess, Glacial till, Universal Soil Loss Equation, Mineral soil, Organic soil, Decomposition, Slope shapes, Runoff, Agriculture, Paleopedology, Topography.

A closed drainage basin representing a catchment for eroded sediment was studied to determine the amount of erosion since cultivation began, and to determine the spatial relationships of the erosion-sedimentation process that had occurred over 145 yr of agriculture. Post-settlement alluvium (PSA) thickness was determined easily in the field as a light-colored mineral soil overlying highly-decomposed sapric organics in the depression. A detailed field study of PSA, of the geologic sediments, loess, and the original till surface in the watershed demonstrated a reduction in the original relief. The mass of PSA served as a measure of the amount of soil eroded from the peripheral slopes. The long-term average soil loss was >26 Mg/ha per year, which represented an average removal of over 24 cm of soil from the entire watershed over 145 yr. The maximum slope in the watershed was 5%. The loess thickness on the surrounding slopes was used as an indication of the spatial variation in erosion processes. Summit positions and convex slope shapes having divergent runoff had the most erosion, whereas concave shapes with convergent runoff exhibited more sedimentation. These results are essentially opposite to those predicted by the Universal Soil Loss Equation. (Author's abstract)
W87-01998

SEEDLING RECRUITMENT OF 11 WETLAND PLANT SPECIES ALONG A WATER LEVEL GRADIENT: SHARED OR DISTINCT RESPONSES,
For primary bibliographic entry see Field 2I.
W87-02257

SHENANDOAH WATERSHED STUDY: CALIBRATION OF A TOPOGRAPHY-BASED, VARIABLE CONTRIBUTING AREA HYDROLOGICAL MODEL TO A SMALL FORESTED CATCHMENT,
Virginia Univ., Charlottesville. Dept. of Environmental Sciences.
For primary bibliographic entry see Field 6A.
W87-02300

GROUND SURFACE SLOPE AS A BASIN SCALE PARAMETER,
Cornell Univ., Ithaca, NY. School of Civil and Environmental Engineering.
For primary bibliographic entry see Field 2A.
W87-02305

5. WATER QUALITY MANAGEMENT AND PROTECTION

5A. Identification Of Pollutants

COMPARISON OF ACRIDINE ORANGE, ACRIFLAVINE, AND BISBENZIMIDE STAINS FOR ENUMERATION OF BACTERIA IN CLEAR AND HUMIC WATERS,
Helsinki Univ. (Finland). Dept. of General Microbiology.
I. Bergstrom, A. Heinanen, and K. Salonen.
Applied and Environmental Microbiology AEMIDF, Vol. 51, No. 3, p 664-667, March 1986. 1 fig, 2 tab, 9 ref.

Descriptors: *Staining methods, *Acridine orange, *Acriflavine, *Bisbenzimide, *Bacteria, *Humic waters, Lake Nimeton, Finland, Lake Syrjanalunen, Color, Fluorescence.

Stains and staining methods suitable for enumerating aquatic bacteria in humic waters were evaluated. In highly humic water (Lake Nimeton, Finland, color 180 mg Pt/liter), acridine orange precipitated with dissolved humic matter, resulting in such bright background fluorescence that no bactria could be seen. With bisbenzimide staining, a similar precipitate was nonfluorescent, but obscured many cells. An acriflavine staining method proved useful and reproducible both in clear (Lake Syrjansalunen, color below 5 mg Pt/l) and humic waters. Fading of fluorescence was not a problem, and stained samples could be stored after preparation. The fluorescence of cells stained with acriflavine was weaker than that with acridine orange, making counting extremely small cells slightly more difficult with the former stain. (Rochester-PTT)
W87-01788

USE OF A BACTERIAL BIOLUMINESCENCE ASSAY TO ASSESS TOXICITY OF CONTAMINATED MARINE SEDIMENTS,
National Marine Fisheries Service, Seattle, WA. Northwest and Alaska Fisheries Center.
M. H. Schiewe, E. G. Hawk, D. I. Actor, and M. M. Krahn.
Canadian Journal of Fisheries and Aquatic Sciences CJFSBX, Vol. 42, No. 7, p 1244-1248, July 1985. 4 tab, 21 ref.

Descriptors: *Bioindicators, *Bioluminescence, *Marine sediments, *Bioassay, *Pollution, *Toxicity, Puget Sound, Washington, Aromatic hydrocarbons, Naphthalenes, Chlorinated hydrocarbons, Bacterial physiology, Metabolism.

Preliminary assays, in which 1 million colony-forming units of Photobacterium phosphoreum (NRRL B 11177) were exposed to sample extracts, established the feasibility of testing methanol-dichloromethane sediment extracts and demonstrated the advantages of solvent-exchanging the extracts into ethanol before testing. Bioluminescence assays were then conducted on extacts of 18 Puget Sound, Washington, sediments, which varied in nature and degree of chemical contamination. Statistical analyses revealed significant associations between acute toxicity expressed as 15-min EC50 (the concentration of extract causing a 50% reduction in bioluminescence after a 15-min exposure) and concentrations of sums of measured aromatic hydrocarbons, naphthalenes, and chlorinated hydrocarbons. The authors conclude that the bioluminescence assay is useful as a rapid method of comparing and ranking the toxicity of organic extracts of contaminated sediments. (Rochester-PTT)
W87-01795

EXCESS UNSUPPORTED 210PB IN LAKE SEDIMENT FROM ROCKY MOUNTAIN LAKES: A GROUNDWATER EFFECT,
Maine Univ. at Orono. Dept. of Geological Sciences.

For primary bibliographic entry see Field 2H.
W87-01796

INFLUENCE OF THE INSECTICIDE DIFLUBENZURON (DIMILIN) ON THE GROWTH OF MARINE DIATOMS AND A HARPACTICOID COPEPOD IN CULTURE,
Department of Fisheries and Oceans, Vancouver (British Columbia). West Vancouver Lab.
For primary bibliographic entry see Field 5C.
W87-01797

SPACE-TIME CORRELATION AND ITS EFFECTS ON METHODS FOR DETECTING AQUATIC ECOLOGICAL CHANGE,
Washington Univ., Seattle. Center for Quantitative Science in Forestry, Fisheries, and Wildlife.
For primary bibliographic entry see Field 7A.
W87-01802

HYPOLIMNETIC OXYGEN CONSUMPTION IN SMALL LAKES,
Toronto Univ. (Ontario). Dept. of Zoology.
For primary bibliographic entry see Field 2H.
W87-01805

RESPONSE OF RADIOACTIVE TRACE METALS TO ACID-BASE TITRATIONS IN CONTROLLED EXPERIMENTAL ECOSYSTEMS: EVALUATION OF TRANSPORT PARAMETERS FOR APPLICATION TO WHOLE-LAKE RADIOTRACER EXPERIMENTS,
Lamont-Doherty Geological Observatory, Palisades, NY.
For primary bibliographic entry see Field 5B.
W87-01821

NUTRIENT ENRICHMENT STUDIES IN A COASTAL PLAIN ESTUARY: PHYTOPLANKTON GROWTH IN LARGE-SCALE, CONTINUOUS CULTURES,
Maryland Univ., Solomons. Chesapeake Biological Lab.
C. F. D'Elia, J. G. Sanders, and W. R. Boynton.
Canadian Journal of Fisheries and Aquatic Sciences CJFSBX, Vol. 43, No. 2, p 397-406, February 1986. 8 fig, 1 tab, 48 ref.

Descriptors: *Patuxent River, *Phytoplankton, *Estuaries, *Ammonium, *Nitrates, *Nutrients, *Seasonal variation, *Plant growth, Plant physiology, Maryland, Nitrogen, Phosphorus, River discharge, Water quality management.

In bioassay experiments employing outdoor 0.5-cu m continuous cultures, freshly inoculated with natural phytoplankton from the Patuxent River (Maryland) estuary, supplements of N, either as ammonium or nitrate, enhanced growth greatly during the low-flow, late-summer season. During late-summer the N:P ratios of dissolved inorganic nutrient standing stocks were characteristically below 5:1 (by atoms). Growth response to N addition was very good (1 day after the start of an experiment), implying that phytoplankton in the bioassay were N limited when removed from the estuary. Addition of PO4(3-) enhanced phytoplankton growth during the late winter, high-flow season, when N:P ratios (as previous) typically exceeded 90:1 (by atoms), but the response lagged enrichment by at least 4 days and biomass levels achieved in these cultures were less than one third of those achieved in the N-enriched cultures during the late summer. The great seasonal variability in river flow, nutrient regimes, and the response of natural phytoplankton assemblages to nutrient enrichment in the Patuxent, and similar estuaries, suggests that management strategies to improve 'water quality' will need to consider N as well as P additions. (Author's abstract)
W87-01854

PROBLEMS OF THE ECOLOGICAL TRANSFORMATION OF RESOURCE USE AND THE DEVELOPMENT OF ECOLOGICAL EVALUATION,
Bulgarian Ecological Society, Svishtov.

For primary bibliographic entry see Field 6A.
W87-01858

CLASSIFICATION OF THE QUALITY OF SURFACE WATERS BY MEANS OF PATTERN RECOGNITION,
Katholieke Univ. Nijmegen (Netherlands). Dept. of Analytical Chemistry.
J. H. M. Bartels, T. A. H. M. Janse, and F. W. Pijpers.
Analytica Chimica Acta ACACAM, Vol. 177, p 35-45, November 31, 1985. 8 tab, 4 fig, 7 ref.

Descriptors: *Water quality, *Chemical composition, *Nitrogen, *Total ionogenic nitrogen, Phosphates, *Nitrogen-redox balance, Pattern recognition procedures, Utrecht, Clustering.

In a pattern recognition procedure applied to about 150,000 observations of chemical and physical conditions of surface water in the province of Utrecht, collected at 110 locations during 1975-1982, a training set of 51 locations described initially by 11 features averaged over four years was selected. This training set provided a learning machine that showed five, mainly geographically distinguishable, clusters with one comprising chloride and conductivity that here has little connection with water quality, and another comprising NH4-N, NO3-N, ortho-phosphate, O2 and BOD that does relate to water quality. Oxygen content and BOD are not important for distinguishing different clusters. A good description of the clustering was found with two (composed) parameters only: total ionogenic nitrogen and phosphate and the nitrogen-redox balance. Based on these two parameters, the patterns of the training set were well separated. Addition of the other sampling locations, collected in a test set comprising 53 locations averaged over the same period of four years, showed the same clearly distinguishable clustering. Projection of patterns from sampling locations of individual years enhanced the intra-cluster variance but did not spoil the clustering. (Alexander-PTT)
W87-01860

IMPROVEMENT OF THE REPRESENTATION OF WATER QUALITY BY APPLICATION OF INFORMATION THEORY,
Katholieke Univ. Nijmegen (Netherlands). Dept. of Analytical Chemistry.
J. H. M. Bartels, T. A. H. M. Janse, F. W. Pijpers, and P. C. Thijssen.
Analytica Chimica Acta ACACAM, Vol. 177, p 47-55, November 31, 1985. 1 fig, 4 tab, 7 ref.

Descriptors: *Water quality, *Information exchange, *Chemical composition, Class boundaries, Geographical maps, Indicative multiyear planning, Information transfer, Water purification.

The quality of surface waters depends on chemical, physical and biological properties. An official definition of normal values of various chemical constitutents for the construction of a classification scale of water quality has been in use for some years; water quality of each sampling location is presented on geographical maps by color codes. The information content of these maps has decreased considerably in recent years, because of improving water quality. A method is described in which a different selection of class boundaries is used so that all classes are well populated, and data are weighted to emphasize extreme situations. This improves the information content of maps, simplifying choices of locations for remedial action. The information content of geographical maps, colored according to the IMP standard method for description of the quality of surface waters, is below the optimal possible information transfer. This is due to the relatively low proportion of the red and orange classes, representing water with inferior quality. Another selection of class boundaries, such that all classes become about equally populated, enhances the entropy of the color-coded maps considerably. A disadvantage of this change is the time-dependence of the judgement, which makes it difficult to compare the situations encountered in successive years. Another approach to the information-transfer problem involves weighting of classes so that extreme situations get a relatively high weight in comparison with normal situations. Such information may be useful when action on water purification is wanted and a location for action has to be chosen from various possible locations. (Alexander-PTT)
W87-01861

EXTENDING THE USE OF CERTIFIED REFERENCE SEDIMENTS FOR ASSESSMENT OF ACCURACY IN DETERMINATIONS OF TRACE METALS,
Department of the Environment, Victoria (British Columbia). Inst. of Ocean Sciences.
For primary bibliographic entry see Field 5B.
W87-01862

SIMULTANEOUS MULTI-ELEMENT DETERMINATION OF TRACE METALS IN SEA WATER BY INDUCTIVELY-COUPLED PLASMA ATOMIC EMISSION SPECTROMETRY AFTER COPRECIPITATION WITH GALLUM,
Tokyo Univ. (Japan). Dept. of Chemistry.
T. Akagi, K. Fuwa, and H. Haraguchi.
Analytica Chimica Acta ACACAM, Vol. 177, p 139-151, November 31, 1986. 6 fig, 6 tab, 32 ref. Ministry of Education, Culture and Science (Japan) Grant in aid 59030023.

Descriptors: *Trace metals, *Water analysis, *Atomic emission spectrometry, *Hydrogen ion concentration, Gallium, Hydroxides, Aluminum, Cobalt, *Chromium, *Iron, Nickel, Zinc, Cadmium, Tokyo Bay, Hiroshima.

Coprecipitation with gallium hydroxide is studied for the preconcentration of trace metals in sea water before multi-element analysis by inductively-coupled plasma/atomic emission spectrometry. Gallium is suitable as a coprecipitation reagent because of its very few spectral interferences and its availability in high purity. The proposed method is simple and uses small amounts of reagents, making the method almost contamination-free. Gallium precipitates at pH 9 only when magnesium is present. Optimum conditions are established for multi-element preconcentration and removal of matrix elements. Highly pure gallium metal is used and only a small amount of sodium hydroxide for pH adjustment is used. Spectral interferences from gallium are negligible and a concentration factor more than 200 can be obtained. Detection limits range from a few nanogram (ng)/liter to 150 ng/liter for Al, Co, Cr, Fe, La, Mn, Ni, Ti, V, Zn, Y, and Pb. Artificial and natural sea-water samples can be analyzed with adequate precision. (Author's abstract)
W87-01863

HYDROLYTIC POTENTIOMETRIC TITRATION OF SULFATE WITH APPLICATION IN THE ANALYSIS OF WATERS,
Maribor Univ. (Yugoslavia). Dept. of Chemical Engineering.
D. Dobcnik, and D. Brodnjak-Voncina.
Analytica Chimica Acta ACACAM, Vol. 177, p 209-212, November 31, 1985. 2 tab, 4 ref.

Descriptors: *Sulfates, *Hydrolysis, *Water analysis, *Cation exchange, Barium, Chromate, Hydrogen ion concentration, River waters, Potable waters, Mineral waters, Calcium, Nitrates, Chlorides, Phosphates.

Sulfate is precipitated with barium ion and excess of barium is precipitated with chromate, excess of which immediately hydrolyses at the end-point to give a sharp jump in pH, measured with a glass electrode. A one to one methanol/water medium is optimal. Appolication to waters requires pretreatment with a cation-exchange resin. River, potable and mineral waters containing 20 to 2000 mg/liter sulphate were analyzed accurately with relative standard devistions of 1 to 2 percennt. The influence of calcium, nitrate, chloride and orthophosphate ions in the titration of 19.5 mg (0.02 mol)/liter sulphate was investigated under the optimal conditions. For calcium/sulphate mole ratios > 1, the results for sulphate were low, thus the use of a

cation-exchange resin is recommended. At phosphate/sulfate ratios > 0.1, the titration curves were deformed. Nitrate and chloride at mole ratios up to 40 did not affect the titration of sulfate, nor did carbonate pH 4.0. (Peters-PTT)
W87-01864

AUTOMATED SYSTEM FOR THE DETERMINATION OF FLUORIDE,
La Trobe Univ., Bundoora (Australia). Analytical Chemistry Labs.
W. L. Chek, and R. W. Cattrall.
Analytica Chimica Acta ACACAM, Vol. 177, p 235-238, November 31, 1985. 2 fig, 1 tab, 10 ref.

Descriptors: *Fluorides, *Automation, *Water analysis, *Ion-selective electrodes, *Computers, Titrations, Victoria, Australia.

A procedure is reported for the automated determination of fluoride by the method of standard addition. Additions of standard are made via a peristaltic pump and the amounts of standard added are computed from the change in weight of the standard in its container on a digital electronic balance. The system that is described is based on a Southwest Technical Products Corporation M6800/2 machine with an Orion 801A digital millivoltmeter; an Apple IIe interfaced with an Orion Model 901 meter has also been used in other work. The automated standard addition method was evaluated on one pure fluoride standard (100.1 microgram/ml) and two samples from an interlaboratory study of fluoride determination conducted by the Environmental Protection Authority of Victoria. The results demonstrate that the automated system is capable of providing acceptable accuracy and precision. (Peters-PTT)
W87-01865

DETERMINATION OF ACETIC, FORMIC, AND PROPANOIC ACIDS IN RAIN WATER BY REVERSE-PHASE HIGH-PERFORMANCE LIQUID CHROMATOGRAPHY,
Commonwealth Scientific and Industrial Research Organization, Aspendale (Australia). Div. of Atmospheric Research.
For primary bibliographic entry see Field 5B.
W87-01866

ISOLATION, IDENTIFICATION, AND GROWTH OF WELL-WATER BACTERIA,
Arizona Univ., Tucson. Dept. of Microbiology and Immunology.
L. D. Stetzenbach, L. M. Kelley, and N. A. Sinclair.
Ground Water GRWAAP, Vol. 24, No. 1, p 6-10, January-February, 1986. 2 fig, 4 tab, 19 ref.

Descriptors: *Bacteria, *Water analysis, *Deep wells, *Potable water, Tucson, Carbon.

The heterotropic bacterial populations present in a well water were isolated and identified and their growth and survival were measured. Two continuously pumping deep ground water wells with similar chemical and physical characteristics were selected as sampling sites for bacterial culture studies. The wells are located on the campus of the University of Arizona, Tucson, and are representative of the deep groundwater wells in this locale which serve as sole sources of potable water. Water from these wells is neither treated nor routinely disinfected. Over 300 bacteria were isolated from well-water samples on a low-nutrient medium (R2A). Gram-negative, rod-shaped nonmotile bacteria predominated, and Acinetobacter spp. comprised 54% of the total number of isolates. Selected isolates were inoculated into unamended and carbon-enriched well water, and growth was measured by acridine orange direct count (AODC). Carbon sources included glucose, acetate, pyruvate, and succinate in 100 microgram carbon/liter and 1,000 ug carbon/liter concentrations. The isolates grew in unamended filtered well water within 24 hours, and growth of an Acinetobacter sp. was further stimulated (greater than two orders of magnitude within five days) in the carbon-enriched well-water. (Peters-PTT)
W87-01869

USE OF GEOPHYSICAL LOGS FOR DETERMINING FORMATION WATER QUALITY,
Woodward-Clyde Consultants, Tallahassee, FL.
T. Kwader.
Ground Water GRWAAP, Vol. 24, No. 1, p 11-15, January-February 1986. 3 fig, 2 tab, 5 ref.

Descriptors: *Borehole geophysics, *Geophysics, *Aquifers, *Resistivity, Southeastern coastal plain, Boreholes, Ion concentrations, Graphical methods, Total dissolved solids, Chlorides, Sulfates, Potassium, Sodium, Magnesium, Hardness.

A summary is presented of an extensive research project where numerous porosity and resistivity logs were compared with actual cores and water-quality samples from wells completed in Tertiary carbonate aquifers of the southeastern Coastal Plain of the United States. In situ water-quality measurements, with respect to various ion and dissolved solids concentrations, have been closely approximated using open-hole borehole geophysical logs. Analyses have shown good correlation between water resistivity and dominant ion concentrations sampled from a wide range of water quality in Tertiary carbonate and granular formations. Water resistivity can be accurately determined by cross-plotting saturated formation resistivity, obtained from normal or lateral resistivity logs, against formation bulk porosity from neutron, density, or acoustic velocity logs. Plotting these data on Hingle Resistivity-Porosity Cross plot paper with the proper matrix cementation factor will yield a graphic solution. The graphical technique also provides information concerning water-quality variations with depth, true matric resistivity, location of confining beds, and vertical changes in formation porosity. Once water resistivity has been determined, other ion concentrations can be estimated based upon chemical analyses of water samples from adjacent wells tapping a similar type water mass. Total dissolved solids, chloride, sulfate, potassium, sodium, magnesium, and hardness concentrations have consistently shown a high correlation with water resistivity. (Peters-PTT)
W87-01870

FACTORS AFFECTING THE MEASUREMENT OF ANTIBIOTIC RESISTANCE IN BACTERIA ISOLATED FROM LAKE WATER,
Freshwater Biological Association, Ambleside (England).
For primary bibliographic entry see Field 2H.
W87-01959

COMPARISON OF MUCILAGE POLYSACCHARIDES EXTRACTED FROM SEWAGE ACTIVATED SLUDGE,
Utsunomiya Univ. (Japan). Dept. of Environmental Chemistry.
For primary bibliographic entry see Field 5D.
W87-01962

ISOLATION AND CHARACTERIZATION OF A CA(++)-DEPENDENT FLOC-FORMING BACTERIUM,
Utsunomiya Univ. (Japan). Dept. of Environmental Chemistry.
For primary bibliographic entry see Field 5D.
W87-01963

DETERMINATION OF ALKYLLEAD SALTS IN RUNOFF, SOILS, AND STREET DUSTS CONTAINING HIGH LEVELS OF LEAD,
Macdonald Coll., Ste. Anne de Bellevue (Quebec). Dept. of Food Science and Agricultural Chemistry.
For primary bibliographic entry see Field 5B.
W87-02090

HEAVY METALS IN COTTONTAIL RABBITS ON MINED LANDS TREATED WITH SEWAGE SLUDGE,
Pennsylvania State Univ. DuBois Campus.
For primary bibliographic entry see Field 5B.
W87-02093

MICROSCALE FLUCTUATION ASSAY COUPLED WITH SEP-PAK(R) CONCENTRATION AS A RAPID AND SENSITIVE METHOD FOR SCREENING MUTAGENS IN DRINKING WATER,
Perugia Univ. (Italy). Cattedra di Igiene.
S. Monarca, J. K. Hongslo, A. Kringstad, and G. E. Carlberg.
Water Research WATRAG, Vol. 19, No. 10, p 1209-1216, 1985. 2 fig, 6 tab, 42 ref.

Descriptors: *Assay, *Drinking water, *Water analysis, *Mutagenicity, *Adsorption, Organic carbon, Trihalomethane, Chlorination, Disinfection, Norway.

A method that combines a microscale fluctuation test with a concentration method based on adsorption on Sep-Pak(R) C18 cartridges for screening drinking water mutagens is described. Sep-Pak adsorbed five times more organics than an XAD-2 concentration method, but was slightly less effective for adsorbing total organic halogen (TOX). The microscale fluctuation test was compared with an Ames test by testing known direct-acting mutagens and concentrates of drinking water. Surface water samples in Norway were concentrated at pH 2 by adsorption on disposable columns. Different doses of adsorbates were tested by microscale fluctuation assay and mutagenic properties were related to total organic carbon, TOX and trihalomethane (THM) concentration. Dose-related mutagenic responses were found for all samples with S. typhimurium TA100 and TA98 and there was a good relationship between mutagenicity data and TOX and THM results. It is shown that this method is simple, rapid and suitable for routine screening of mutagens in drinking water. (Michael-PTT)
W87-02148

IDENTIFICATION OF VIRUSES ISOLATED FROM SEWAGE, RIVERWATER AND COASTAL SEAWATER IN BARCELONA,
Barcelona Univ. (Spain). Dept. of Microbiology.
F. Lucena, A. Bosch, J. Jofre, and L. Schwartzbrod.
Water Research WATRAG, Vol. 19, No. 10, p 1237-1239, 1985. 5 tab, 13 ref.

Descriptors: *Viruses, *Barcelona, Spain, *Water sampling, *Sewage, *Rivers, *Seawater, Poliovirus.

Enteric viruses were isolated in water samples from a sewage outlet, two rivers and three beaches during a virological survey in Barcelona, Spain. Poliovirus (prevalent strain vaccine type 3) was detected in all water samples under study. (Michael-PTT)
W87-02151

ISOLATION OF YERSINIA FROM SURFACE WATER: COMPARATIVE STUDY OF THREE SELECTIVE MEDIA,
Nancy-1 Univ. (France). Lab. d'Hygiene et de Recherche de la Sante Publique.
F. Agbalika, M. Soltandallal, and P. Hartemann.
Water Research WATRAG, Vol. 19, No. 10, p 1255-1258, 1985. 2 fig, 3 tab, 19 ref.

Descriptors: *Yersinia, *Isolation, *Surface water, *Agar, *Bacterial analysis, Moselle River, Bacteria, Sample preparation, Water sampling, Culture media.

Three selective agar media were compared for the isolation of Yersinia bacteria from surface water samples taken from the Moselle River. Isolation frequency with Y-M agar (27%) was higher than that with CAL agar of Y medium. Y-M agar exhibited a wide diversity of species, including Y. enterocolitica, Y. frederiksenii, Y. kristensenii and Y. intermedia. The aerobic cold-enrichment technique without culture broth was shown to be adequate for the isolation of Yersinia. (Michael-PTT)
W87-02154

VARIATION OF THE BLOOD LEAD LEVEL AS A RESULT OF LEAD CONTAMINATION

OF THE SUBJECTS DRINKING WATER (VARIATION DE LA PLOMBEMIE EN FOUCTION DE LA CONTAMINATION PAR LE PLOMBM DE L'EAU LIVREE A LA CONSOMMATION),
Direction Dept. des Affaires Sanitaires et Sociales des Vosges, Epinal (France).
For primary bibliographic entry see Field 5C.
W87-02160

COMPARISON OF FOUR CHROMOGENIC REAGENTS FOR THE FLOW-INJECTION DETERMINATION OF ALUMINIUM IN WATER,
Norsk Inst. for Skogforskning, Aas. Div. of Forest Ecology.
O. Royset.
Analytica Chimica Acta ACACAM, Vol. 178, No. 2, p 223-230, December 15, 1985. 5 fig, 2 tab, 14 ref.

Descriptors: *Chromogenic reagents, *Flow-injection determination, *Water analysis, *Chromatography, *Colorimetry, *Aluminium, Pollution, Metals.

Pyrocatechol violet (PCV), aluminon, eriochrome cyanine R (ECR) and eriochrome cyanine R with cetyltrimethylammonium bromide (ECR/CTA) have been compared as chromogenic reagents for the flow-injection determination of aluminium in water. The detection limit of the ECR/CTA method is 1 microgram Al/l, and of the PCV and ECR methods are 5 microgram Al/l. Interference from iron, fluoride, phosphate and the acidity of the sample were investigated. The interference from iron was suppressed by hydroxylammonium chloride/1,10-phenanthroline in the PCV and ECR/CTA methods at concentrations less than 5 mg Fe/l. In the ECR and aluminon methods, iron (<5 mg/l) has been masked by ascorbic acid. Fluoride at <0.2 mg/l can be tolerated in all methods. The aluminon method could tolerate up to about 500 mg/l phosphate-P, but phosphate is said to interfere at concentrations higher than 5 mg P/l in the three other methods. All methods are sensitive to changes in acidity of the samples; the acidity should be 0.08-0.12 M HCl. (Author's abstract)
W87-02165

SEPARATION AND AUTOMATIC SPECTROPHOTOMETRIC DETERMINATION OF LOW CONCENTRATIONS OF CYANIDE IN WATER,
Budapesti Mueszaki Egyetem (Hungary). Inst. for General and Analytical Chemistry.
M. Hangos-Mahr, E. Pungor, and V. Kuznecov.
Analytica Chimica Acta ACACAM, Vol. 178, No. 2, p 289-298, December 15, 1985. 7 fig, 6 tab, 27 ref.

Descriptors: *Separation, *Water analysis, *Cyanide, *Spectrophotometry, *Semi-automatic method, Infra-red, Photometery, Pollutants, Trace levels.

Semi-automatic methods have been described for the routine determination of cyanide in water. Membrane diffusion and isothermal distillation were examined for the separation/concentration of cyanide. An air-segmented flow analyzer was used to quantify cyanide. Two classical spectrophotometric methods had been adapted and compared. At cyanide concentrations exceeding 1 mg/l, the method based on reaction with picric acid was applicable. A modified Aldridge method was said to be far better for lower concentrations. Combination of isothermal distillation with the automatic version of the Aldridge method was suitable for the determination of cyanide in waters in the concentration range 0.01-10 mg/l. Interference by sulphide and sulphite and their removal is described. (Author's abstract)
W87-02166

USE OF DISPOSABLE CLEAN-UP COLUMNS FOR SELECTIVE REMOVAL OF HUMIC SUBSTANCES PRIOR TO MEASUREMENTS WITH A NITRATE ION-SELECTIVE ELECTRODE,
Lund Univ. (Sweden). Dept. of Analytical Chemistry.
I. Csiky, G. Marko-Varga, and J. A. Jonsson.
Analytica Chimica Acta ACACAM, Vol. 178, No. 2, p 307-312, December 15, 1985. 2 fig, 4 tab, 16 ref.

Descriptors: *Clean-up column, *Water analysis, *Nitrates, *Humic substances, *Removal, *Eutrophication, *Ion-selective electrode, Pollution, Humic acids, Ion-chromatography.

Determination of nitrate in soils and natural waters is important while studying the eutrophication of waters. Humic substances are inevitably present in such samples and cause severe interferences in most methods for determining nitrate. Nitrate is often determined with a nitrate ion-selective electrode, but spectrophotmetric and ion-chromatographic methods have also been used. Recently, the use of a clean-up column for selective removal of humic compounds had been reported prior to ion-chromatographic determinations of nitrate and sulfate. A sample clean-up prior to measurements by ion selective electrode was investigated. The disposable columns had been packed with chemically-bonded amine material. The method was applied to natural water samples with high contents of humic substances. The nitrate concentrations found were in good agreement with determinations by ion chromatography. (Khumbatta-PTT)
W87-02167

INFLUENCE OF TRANSITION METAL COMPLEXES ON ATMOSPHERIC DROPLET ACIDITY,
Bell Labs., Murray Hill, NJ.
For primary bibliographic entry see Field 2B.
W87-02173

POTENTIALLY TOXIC CONCENTRATIONS OF TRIETHYL LEAD IN BLACK FOREST RAINWATER SAMPLES,
Max-Planck-Inst. fuer Medizinische Forschung, Heidelberg (Germany, F.R.). Abt. Physiologie.
H. Faulstich, and C. Stournaras.
Nature NATUAS, Vol. 317, No. 6039, p 714-715, October 24, 1985. 2 fig, 16 ref.

Descriptors: *Toxic pollutants, *Lead, *Water pollution sources, *Triethyl lead, *Black Forest, *Rain water, Precipitation, Pollution, Atomic absorption, Heavy metals.

European forest damage is speculated to have been caused by the continual exposure of trees to rainwater which is said to contain trialkyl lead salts (R3PbX; R = ethyl, methyl). These are said to be degradation products of tetraalkyl lead (R4Pb) which are added to petroleum as anti-knock agents; they inhibit the tubulin polymerization and are highly toxic to mammalian and plant cells. The analysis is made of rainwater samples collected at two sites in the Black Forest, FRG, where the total lead content were measured by atomic absorption and were found to be in the the range previously determined for rural areas. The portion of R3PbX was assayed by the inhibition of pork brain tubulin polymerization. R3PbX was present in one-third of all rainwater samples. The highest concentration was 0.3 micromolar which is 1000 times higher than previously reported. For comparison, 1 micromolar R3PbX killed soybean cells or neuroblastoma cells in culture. (Author's abstract)
W87-02175

MEASUREMENT OF ORGANIC CARBON IN POLAR SNOW SAMPLES,
New Hampshire Univ., Durham. Dept. of Earth Sciences.
M. S. Twickler, M. J. Spencer, W. B. Lyons, and P. A. Mayewski.
Nature NATUAS, Vol. 320, No. 6058, p 156-158, March 13 1986. 1 fig, 1 tab, 36 ref. EPA Grant APP-0306-1983.

Descriptors: *Organic carbon, *Snow, *Polar snow, Carbon isotopes, Carbon-14, Precipitation, Firn, Palaeoatmospheres.

Glaciers provide a unique medium for the study of palaeoatmospheric chemistry, particularly the polar glaciers where chemical records may be preserved for at least several hundred thousand years. Gaseous forms of organic carbon have been reported in polar ice but these are considered the first measurements of organic carbon from polar firn samples. These measurements are the lowest reported for organic carbon in precipitation. Dissolved organic carbon in Greenland snow has a seasonal deposition pattern with higher concentrations observed in the winter/spring period. The source of the organic carbon in Greenland snow could not be identified, but three possibilities are discussed. The dissolved organic carbon may be an input of marine organic carbon and be similar in source to Cl(-) or it may represent a natural continental source similar to Al(+3) or it may have its origin from an anthropogenic source similar to the winter/spring SO4(--) signal. (Khumbatta-PTT)
W87-02178

PRECISION OF A FIELD METHOD FOR DETERMINATION OF PH IN DILUTE LAKES,
Geological Survey, Lakewood, CO. Water Resources Div.
J. T. Turk.
Water, Air, and Soil Pollution WAPLAC, Vol. 27, No. 3/4, p 237-242, 1986. 1 fig, 1 tab, 8 ref. EPA Interagency agreement AD-14-F2A262.

Descriptors: *Hydrogen ion concentration, *Dilute lakes, Extreme weather conditions, Colorado, Field measurements, pH meter, Buffers.

An onsite method for determination of pH in dilute lakes and documentation of the precision of the method are presented. Replicate pH measurements were taken with a pH meter in three dilute lakes during extreme conditions. Results indicate that pH can be measured in the field with a variance due to measurement error of 0.005 unit. Error of the field technique in measuring the pH of dilute solutions in the laboratory ranged from less than 0.01 unit in dilute strong-acid solutions to about 0.05 unit in air-saturated deionized water. (Main-PTT)
W87-02186

REACTOR TECHNIQUE FOR PREDICTION OF DISSOLVED OXYGEN PROFILES IN STREAMS,
Virginia Polytechnic Inst. and State Univ., Blacksburg.
J. H. Sherrard, R. C. Hoehn, and J. F. Salgado.
Water, Air, and Soil Pollution WAPLAC, Vol. 27, No. 3/4, p 259-266, 1986. 6 fig, 7 ref.

Descriptors: *Dissolved oxygen profiles, *Streams, Streeter Phelps model, Dissolved oxygen meter, Bactopeptone, Open-stirred reactor, Wastewater, Carbonaceous oxygen demands, Nitrogenous oxygen demands.

A laboratory experiment that can provide significant design information to environmental scientists and engineers can be performed rapidly and inexpensively with an open stirred-reactor that simulates a receiving stream. The experiment requires only a laboratory beaker, stirring apparatus, dissolved oxygen meter, wastewater sample, and receiving stream sample. Wastewater and receiving stream water are mixed in the beaker and stirred at different speeds to obtain different reaeration rates. A probe is used to monitor dissolved oxygen concentrations of the mixture. A series of experiments were performed at different waste loadings and different reaeration rates. Sample results are shown which indicate that the depletion of dissolved oxygen is due both to carbonaceous and nitrogeneous oxygen demands. This technique can be used to predict response of a receiving stream to a waste discharge without use of a mathematical model. Results are shown which illustrate the difference between experimental results and theoretical predictions. (Author's abstract)
W87-02188

STABLE SULFUR ISOTOPE RATIOS AS A TOOL FOR INTERPRETING ECOSYSTEM SULFUR DYNAMICS,

Syracuse Univ., NY. Dept. of Civil Engineering.
R. D. Fuller, M. J. Mitchell, H. R. Krouse, B. J. Wyskowski, and C. T. Driscoll.
Water, Air, and Soil Pollution WAPLAC, Vol. 28, No. 1/2, p 163-171, 1986. 4 fig, 27 ref.

Descriptors: *Sulfur isotopes, *Ecosystems, Soil leachates, Precipitation, Stream solutions, New Hampshire, Mass spectrometry, Soil horizons.

Stable S isotope ratios (delta34S) were evaluated in soil solution leachates, soluble plus adsorbed soil SO4(2-), soil organic S, precipitation, and stream solutions along an elevational gradient at the Hubbard Brook Experimental Forest in New Hampshire. The delta34S of soil organic S varied with soil horizon and vegetation type, but was generally more negative than adsorbed or soil solution SO4(2-). In the Bh horizon, delta34S of organic S was typically more negative than the Oa horizon or lower mineral soil. The patterns suggest a combination of plant and microbial fractionation processes. Stream delta34S values decreased with decreasing elevation and were correlated with decreases in SO4(2-) concentration, suggesting an additional S source in higher elevation coniferous sites with a unique delta 34S. (Author's abstract)
W87-02204

OCCURRENCE IN WATER OF VIRUSES OF PUBLIC HEALTH SIGNIFICANCE,

Welsh Water Authority, Powys.
For primary bibliographic entry see Field 5B.
W87-02209

POLLUTION OF FRESHWATER AND ESTUARIES,

North West Water Authority, Warrington (England).
W. R. White, and A. F. Godfree.
Journal of Applied Bacteriology (Symposium Supplement) JABAA4, 67S-79S, 1985. 7 fig, 3 tab, 20 ref.

Descriptors: *Rivers, *Estuaries, *Microorganisms, *Monitoring, Escherichia coli, Feces, Bacteria, Seagulls, Wastewater disposal, England, Water quality, Public health, Water pollution.

The importance of monitoring microbiological parameters such as fecal indicator bacteria for water quality management of rivers and estuaries is discussed. Principal inputs of the fecal indicator bacteria parameter such as E. coli and sewage effluent discharge are reviewed for several rivers in England. It is recommended that microbiological parameters be used to monitor surface water quality and that more information be obtained on the factors affecting microorganism survival, the best organisms to use as bacteriological indicators and the relationship between the presence of microorganisms and public health problems. (Michael-PTT)
W87-02212

CHARACTERIZATION OF MICROBIAL POPULATIONS IN POLLUTED MARINE SEDIMENTS,

Dunstaffnage Marine Research Lab., Oban (Scotland).
R. J. Parkes, and J. Taylor.
Journal of Applied Bacteriology (Symposium Supplement) JABAA4, p 155S-173s, 1985. 5 fig, 5 tab, 114 ref.

Descriptors: *Water pollution, *Marine bacteria, *Marine sediments, *Microscopic analysis, *Bacterial analysis, Fluorescence, Radioactive tracers, Oxygen uptake, Biochemistry, Adenosine triphosphate.

The relative benefits and limitations of techniques for characterizing microbial populations and determining bacterial activity in polluted marine sediments are discussed. Direct microscopic counting techniques include epifluorescence microscopy, autoradiography, the fluorescent antibody technique and direct counting of actively respiring bacteria and the frequency of dividing cells. Bacterial activity measurement techniques include radioactive tracer methods and measurement of electron transport activity, sediment oxygen uptake and microbial productivity. Biochemical measures of biomass using adenosine triphosphate and analysis of microbial cell wall constituents are also evaluated. The complexity of the sediment environment dictates that all methods used to characterize bacterial populations be evaluated with an understanding of their limitations and an awareness of the difficulty in applying conversion factors derived from laboratory isolates which may have different compositions and properties than sediment bacteria. (Michael-PTT)
W87-02217

CHARACTERIZATION OF COMMERCIAL AROCLORS BY AUTOMATED MASS SPECTROMETRIC DETERMINATION OF POLYCHLORINATED BIPHENYLS BY LEVEL OF CHLORINATION,

Environmental Monitoring and Support Lab.-Cincinnati, OH.
A. L. Alford-Stevens, T. A. Bellar, J. W. Eichelberger, and W. L. Budde.
Analytical Chemistry ANCHAM, Vol. 58, No. 9, p 2014-2022, August 1986. 1 fig, 6 tab, 20 ref.

Descriptors: *Pollution identification, *Polychlorinated biphenyls, *Aroclors, *Mass spectrometry, *Chlorination, Measuring instruments, Gas chromatography, Calibration, Water sampling, Computers, Chlorinated hydrocarbons, Detection limits.

An automated technique for identification and measurement of the presence of polychlorinated biphenyls (PCB) formulations (manufactured and sold as Aroclors) in which PCBs are characterized by level of chlorination using PCB congeners to calibrate a mass spectrometry detector is described. Although individual PCBs were not identified, this procedure provided information on relative retention time, relative abundance and level of congener chlorination represeted as gas chromatographic peaks. Individual Aroclors can be easily determined, and, while mixed determinations are possible, they are impractical for routine analysis of environmental samples. The accuracy of this approach depends on the similarity of injected quantities of sample extracts and solutions containing reference Aroclors. Detection limits are estimated for individual components of isomer groups measured in extracts of reagent water fortified with mixed Aroclors. (See also W87-02230) (Michael-PTT)
W87-02229

ACCURACY AND PRECISION OF DETERMINATION OF CHLORINATED PESTICIDES AND POLYCHLORINATED BIPHENYLS WITH AUTOMATED INTERPRETATION OF MASS SPECTROMETRIC DATA,

Environmental Monitoring and Support Lab.-Cincinnati, OH.
A. L. Alford-Stevens, T. A. Bellar, J. W. Eichelberger, and W. L. Budde.
Analytical Chemistry ANCHAM, Vol. 58. No. 9, p 2022-2029, August 1986. 2 fig, 3 tab, 21 ref.

Descriptors: *Pollutant identification, *Pesticides, *Chlorinated hydrocarbons, *Polychlorinated biphenyls, *Computers, *Mass spectrometry, *Data interpretation, Water analysis, Detection limits, River water.

The accuracy and precision of the Environmental Protection Agency's Method 680 for identification of polychlorinated biphenyls (PCBs) according to level of chlorination was evaluated using computer-assisted analysis of the mass spectra of PCBs and 21 chlorinated pesticides present in water samples. A splitless, cold-trapping technique was used to alleviate the problem of variability of pesticide analyte relative retention times caused by nonreproducible initial column temperature. In the three sets of fortified water extracts, the largest relative standard deviation of replicate measurements was 8.4% for individual pesticides, 16% for PCB isomer groups and 2.9% for total PCBs. Method bias was calculated for each of the three data sets and highest bias was observed with river water extracts. The detection limit for each pesticide in reagent waater is approximately one microgram per liter. (See also W87-02229) (Michael-PTT)
W87-02230

DETERMINATION OF SELECTED NEUTRAL PRIORITY ORGANIC POLLUTANTS IN MARINE SEDIMENT, TISSUE, AND REFERENCE MATERIALS UTILIZING BONDED-PHASE SORBENTS,

Environmental Protection Agency, Narragansett, RI.
R. J. Ozretich, and W. P. Schroeder.
Analytical Chemistry ANCHAM, Vol. 58, No. 9, p 2041-2048, August 1986. 1 fig, 9 tab, 13 ref.

Descriptors: *Pollutant identification, *Organic compounds, *Marine sediments, *Animal tissues, Extraction procedures, Detection times, Marine animals, Solvents, Silica, Tissue analysis.

Extraction and cleanup procedures that use a single solvent and prepackaged, bonded phase silicas for recovery of neutral priority organic compounds from contaminated marine sediments, marine animal tissue and reference materials are described. Recoveries compared favorably with published mean values. Recovery efficiencies were determined by spiking marine sediments and a mussel tissue homogenate. Mean recoveries of 22 priority organic pollutants from sediments ranged from 0 to 84% with a mean recovery of 71% and a 9% relative standard deviation. Mean recoveries of 13 priority organic pollutants from tissue homogenate ranged from 7% to 76% with a median recovery of 64% and 5% deviation. The effects of sediment type and storage method on spike recoveries are also discussed. This method can result in significant reductions in time, solvent volume and complexity of procedures used to extract, clean and fractionate marine sediment and tissue samples for organic pollutant analysis. (Michael-PTT)
W87-02231

EVALUATION OF GRAPHITIZED CARBON BLACK CARTRIDGES FOR RAPID ORGANIC TRACE ENRICHMENT FROM WATER: APPLICATION TO PRIORITY POLLUTANT PHENOLS,

Rome Univ. (Italy). Dept. of Chemistry.
C. Borra, A. Di Corcia, M. Marchetti, and R. Samperi.
Analytical Chemistry ANCHAM, Vol. 58, No. 9, p 2048-2052, August 1986. 2 fig, 6 tab, 17 ref.

Descriptors: *Carbon black, *Pollution identification, *Phenols, *Water analysis, *Enrichment, Polarity, Graphite, Detection limits, Surface water, Chlorophenol.

The feasibility of using trace enrichment of pollutant phenols on a graphitized carbon black (GCB) cartridge to retain very polar compounds from water samples was evaluated. Optimization studies were performed to quantitatively recover phenols from the GBC surface. Phenol recovery was not affected by sampling rate. Sorbent extraction efficiency was determined by sampling up to four liters of distilled water. Even at this rate, only phenol and part of o-chlorophenol was lost. The matrix effect was identified by extracting phenols spiked in water samples from different sources. Phenol trapping efficiency of the GCB method was compared with that of a C18 bonded phase column. The GCB water analysis technique resulted in determination of phenols with a detection limit of 4-40 parts per trillion (pptr), except for phenol which was detected at 250 pptr in surface water. (Author's abstract)
W87-02232

DETERMINATION OF BERYLLIUM IN NATURAL WATERS IN REAL TIME USING ELECTRON CAPTURE DETECTION GAS CHROMATOGRAPHY,

Massachusetts Inst. of Tech., Cambridge. Dept. of Earth and Planetary Sciences.
C. I. Measures, and J. M. Edmond.
Analytical Chemistry ANCHAM, Vol. 58, No. 9,

p 2065-2069, August 1986. 5 fig, 3 tab, 15 ref.

Descriptors: *Pollutant identification, *Beryllium, *Electron capture gas chromatography, *Natural waters, Seawater, Detection limits, River water, Rain water, Trace elements, Water analysis.

A method for real time determination of beryllium in seawater at ocean concentration levels using electron capture gas chromatography is described. The technique detects the 1,1,1-trifluoro-2,4-pentanedione derivative and has a detection limit of about 2 pM and a relative precision of plus or minus 5% at 23 pM. Sample contamination control requirements to achieve determination at this level is described. The method has been applied to stored acidified seawater samples in the laboratory and at sea on three oceanographic cruises. The method has also been used to detect beryllium in other natural waters, including rain water, hydrothermal fluids and aqueous digests of rocks. This technique provides considerable advantages in terms of sensitivity, lower sample volume requirements and suitability for use at sea. (Michael-PTT)
W87-02233

ANALYSIS OF ELEVEN TRIAZINES IN NATURAL WATERS,
Canada Centre for Inland Waters, Burlington (Ontario).
H. B. Lee, and Y. D. Stokker.
Journal - Association of Official Analytical Chemists JANCA2, Vol. 69, No. 4, p 568-572, July-August 1986. 4 fig, 4 tab, 28 ref.

Descriptors: *Triazines, *Pollutant identification, *Herbicides, *Natural waters, *Water analysis, Gas chromatography, Nitrogen phosphorus detectors, Lake Ontario, Detection limits, Simetone, Simetryne.

A validated procedure for quantitative determination of 11 triazine herbicides in natural water using gas chromatography with a nitrogen phosphorus detector is described. Triazine residues were extracted from water by methylene chloride and cleaned up on a 10% deactivated Florisil column using 3% methanol in benzene as eluant. Extracts were quantified in two separate runs and could be analyzed in a single run. The method has been validated at 10, 1 and 0.1 micrograms per liter using fortified distilled water and samples of Lake Ontario water. Triazine recoveries at all levels of fortification ranged from 87% to 108% with the exception of simetone and simetryne which were about 80% recovered in certain cases. The detection limit for all traizines in this method is 0.025 micrograms per liter. (Author's abstract)
W87-02234

IDENTIFICATION OF CIS- AND TRANS-1,1,2,3,4-PENTACHLORO-4-(1-METHYLETHOXY)-1,3-BUTADIENE RESIDUES IN MISSISSIPPI RIVER FISH,
Food and Drug Administration, Washington, DC. Div. of Chemical Technology.
M. P. Yurawecz, J. Y. T. Chen, and B. J. Puma.
Journal - Association of Official Analytical Chemists JANCA2, Vol. 69, No. 4, p 586-591, July-August 1986. 4 fig, 3 tab, 15 ref.

Descriptors: *1,1,2,3,4-Pentachloro-4-(1-methylethoxy)-1,3-butadiene, *Isomers, *Residues, *Pollutant identification, *Pesticides, *Buffalo fish, Organophosphorus compounds, Organochlorine compounds, Mississippi River, Contamination, Mass spectrometry.

Tissue analysis of buffalo fish suspected to be contaminated by cis- and trans-isomers of 1,1,2,3,4-pentachloro-4-(1-methylethoxy)-1,3-butadiene taken from the Mississippi River at and near St. Louis, MO was performed by using the AOAC multiresidue method for detecting organochlorine and organophosphorus pesticides. In tests on spiked fish, both isomers were quantitatively recovered and a mixture of the isomers was synthesized by reacting hexachlorobutadiene with sodium isopropoxide. Separation of the reaction products provided reference standards of the individual isomers for identification and quantification of the residues. The stereospecificity of the synthesis reaction is discussed and infrared and mass spectral data are presented. (Author's abstract)
W87-02235

DETERMINATION OF TRACE METALS IN LOW IONIC STRENGTH WATERS USING ZEEMAN AND DEUTERIUM BACKGROUND CORRECTION FOR GRAPHITE FURNACE ATOMIC ABSORPTION SPECTROMETRY,
Geological Survey, Arvada, CO.
M. J. Fishman, G. R. Perryman, L. J. Schroder, and E. W. Matthews.
Journal Association of Official Analytical Chemists JANCA2, Vol. 69, No. 4, p 704-708, July-August 1986. 5 tab, 8 ref.

Descriptors: *Trace metals, *Water analysis, *Ions, *Deuterium, *Atomic absorption spectroscopy, Cadmium, Chromium, Cobalt, Copper, Lead, Manganese, Nickel, Zinc, Detection limits.

Two U.S. Geological Survey water quality laboratories evaluated Zeeman and deuterium background correction techniques for graphite furnace atomic absorption spectroscopy detection of trace metals in low ionic water. A L'vov-type platform was used to determine the presence of cadmium, chromium, cobalt, copper, lead, manganese, nickel and zinc in blind samples of water. Matrix modifiers were used to determine cadmium, chromium, lead, manganese and zinc. Results were comparable for all metals, except cadmium and nickel. Detection limits can be changed by varying the sample injection volume, using multiple injections or changing the analytical wavelength. Analytical ranges for a 20 microliter sample volume are presented. (Michael-PTT)
W87-02236

COMPARATIVE STUDY OF MEMBRANE FILTRATION AND ENRICHMENT MEDIA FOR THE ISOLATION AND ENUMERATION OF PSEUDOMONAS AERUGINOSA FROM SEWAGE, SURFACE WATER, AND SWIMMING POOLS,
Rijksinstituut voor de Volksgezondheid en Milieuhygiene, Bilthoven (Netherlands). Lab. for Water and Food Microbiology.
A. H. Havelaar, M. During, and E. H. M. Delfgou-Van Asch.
Canadian Journal of Microbiology CJMIAZ, Vol. 31, No. 8, p 686-692, August 1985. 9 tab, 26 ref.

Descriptors: *Membrane filters, *Enrichment, *Pseudomonas aeruginosa, *Wastewater, *Surface water, *Whirlpools, *Culture media, Water analysis, Bacterial analysis, Bacteria, Chlorination, Cellulose acetate membranes.

A comparative study of membrance filtration and enrichment media for isolation and enumeration of Pseudomonas aeruginosa from raw sewage, secondary effluent, river water and whirlpool water is presented. An mPA-B medium gave good recovery of both vital and chlorine-injured P. aeruginosa and is recommended for use in analysis of chlorinated swimming pool water. Analysis of sewage-polluted water with this medium showed reduced selectivity due to low verification rates and overgrowth by competitive flora. An mPA-D medium that was modified by addition of cetrimide and omission of sulphapyridine and actidione was more selective, but chlorine injured cells were completely inhibited. A C-390 medium was highly selective, but could not be used with conventional membrance filtration because cellulose ester filters interfered with the selective action. Selectivity could be improved by using polysulphone filters and increasing the C-390 concentration, but it was strongly inhibitory to P aeruginosa. Two other filtration media were tested which were inhibitory to chlorine-injured cells. There was little difference between the several types of membrane filters that were tested. Asparagine broth showed good recovery in a most-probable-number technique while malachite green broth was inhibitory to chlorine-injured cells. (Michael-PTT)
W87-02254

CHEMICAL AND BACTERIOLOGICAL COMPOSITION OF GRANULAR METHANOGENIC SLUDGE,
Agricultural Univ., Wageningen (Netherlands). Dept. of Microbiology.
For primary bibliographic entry see Field 5D.
W87-02255

ETHYLENE PRODUCTION BY POTATO, RADISH, AND SOYBEAN LEAF TISSUE TREATED WITH SIMULATED ACID RAIN,
Ohio Agricultural Research and Development Center, Wooster. Dept. of Plant Pathology.
For primary bibliographic entry see Field 5C.
W87-02265

OPTICAL PROPERTIES OF NEW ZEALAND LAKES: II. UNDERWATER SPECTRAL CHARACTERISTICS AND EFFECTS ON PAR ATTENTUATION,
Department of Scientific and Industrial Research, Taupo (New Zealand). Div. of Marine and Freshwater Sciences.
For primary bibliographic entry see Field 2H.
W87-02309

ORGANIC INDICATORS OF GROUNDWATER POLLUTION BY A SANITARY LANDFILL,
Consejo Superior de Investigaciones Cientificas, Madrid (Spain).
J. Albaiges, F. Casado, and F. Ventura.
Water Research WATRAG, Vol. 20, No. 9, p 1153-1159, September 1986. 7 fig, 2 tab, 24 ref.

Descriptors: *Organic compounds, *Groundwater pollution, *Sanitary landfills, *Barcelona, *Spain, Carboxylic acids, Proteins, Lipids, Lignins, Nicotine, Caffeine, Phthalates, Leachates.

The organic composition of leachate from the Barcelona sanitary landfill is described. According to the low degree of stabilization of the disposed garbage, the acid fraction accounts for 80-90% of the total organic extract. More than 50 individual organic components have been identified, indicating catabolic degradation of lipids (e.g. C4-C11 carboxylic acids), proteins (e.g. indole derivatives) and lignins (e.g. p-hydroxyphenyl derivatives) or simply compounds originally present in the refuse that have been washed out by percolating waters (nicotine, caffeine, phthalates). To obtain a monitoring system for the groundwater pollution originated by this landfill leachate, an analytical method is proposed based on the GC-ECD fingerprinting of groundwater acidic extracts after derivatization with pentafluorobenzyl bromide. The chromatogram contains carboxylic and phenolic components and the profiles exhibited by waters from several test wells in the downstream edge of the landfill were indicative of the suspected leachate pollution. (Author's abstract)
W87-02362

DETERMINATION OF TOTAL PHOSPHORUS IN SEAWATER BY NITRATE OXIDATION OF THE ORGANIC COMPONENT,
British Columbia Univ., Vancouver.
A. D. Cembella, N. J. Antia, and F. J. R. Taylor.
Water Research WATRAG, Vol. 20, No. 9, p 1197-1199, September 1986. 3 tab, 10 ref.

Descriptors: *Phosphorus, *Seawater, *Nitrate oxidation, *Chemical analysis, Organic compounds, Oxidation, Organic phosphorus, Esters, Anhydrides.

The determination of total phosphorus dissolved in seawater is achieved by the magnesium nitrate oxidation of the organic component, concomitant with depolymerization of polyphosphate residues, followed by the standard molybdate colorimetric determination of the liberated orthophosphate. This method gave 93-100% recovery of phosphorus from inorganic metaphosphate and polyphosphate, phosphate esters and anhydrides, nucleotide-P, phospholipid and phosphonates. It is shown to be superior to the perchlorate-oxidation or high-intensity u.v.-irradiation methods for quantitative P

recovery from phosphonates and polyphosphates, while proving equal in P recovery to the autoclave-requiring persulfate-oxidation method. (Author's abstract)
W87-02367

NITROGEN-ISOTOPE STUDY OF THE SOURCES OF NITRATE CONTAMINATION IN GROUNDWATER OF THE PLEISTOCENE COASTAL PLAIN AQUIFER, ISRAEL,
Weizmann Inst. of Science, Rehovoth (Israel). Dept. of Isotope Research.
For primary bibliographic entry see Field 5B.
W87-02406

ACTIVATED SLUDGE RESPIROMETRIC MEASUREMENTS,
United Nations Development Programme, Maputo (Mozambique).
For primary bibliographic entry see Field 5D.
W87-02407

COMPARISON OF POSITIVELY CHARGED MEMBRANE FILTERS AND THEIR USE IN CONCENTRATING BACTERIOPHAGES IN WATER,
Florida Univ., Gainesville. Dept. of Microbiology and Cell Science.
P. A. Shields, T. F. Ling, V. Tjatha, D. O. Shah, and S. R. Farrah.
Water Research WATRAG, Vol. 20, No. 2, p 145-151, February, 1986. 4 fig, 5 tab, 22 ref. EPA Grant R810126-01-0.

Descriptors: *Membrane filters, *Bacteriophages, *Bacterial analysis, *Water analysis, Adsorption, Carbon tetrachloride, Salt, Filtration, Detergents.

Virus adsorption-elution studies and physical measurements were performed on four electro-positive membrane filters to evaluate their effectiveness in concentrating bacteriophages in water. The relative hydrophobicity of the filters was determined by measuring the contact angle of carbon tetrachloride with the filters and their rate of rise of hexadecane and water. Viruses adsorbed to the least hydrophobic filter could be eluted by using a salt solution alone to diarupt electrostatic interactions between viruses and the filter. Solutions of salt and detergent were needed to elute virus adsorbed to two of the more hydrophobic filters which indicated that both electrostatic and hydrophobic interactions were responsible for viral adsorption. A two-step procedure that used a different filter for each step was developed for recovering bacteriophages from water. Virosorb 1MDS was used to adsorb indigenous phage in water samples and adsorbed virus could be recovered by treating the filter with salt solution. Phages in this solution could be further concentrated by a second adsorption-elution step that used a Seitz S filter. (Author's abstract)
W87-02408

VOLATILE OZONIZATION PRODUCTS OF AQUEOUS HUMIC MATERIAL,
Bristol Univ. (England). Organic Geochemistry Unit.
For primary bibliographic entry see Field 5F.
W87-02409

SIMULTANEOUS DETERMINATION OF TOTAL ORGANIC CARBON AND TOTAL NITROGEN IN WATERS BY PYROLYSIS-GAS CHROMATOGRAPHY-MASS SPECTROMETRY,
Government Industrial Research Inst., Nagoya (Japan).
K. Nakajima.
Water Research WATRAG, Vol. 20, No. 2, p 233-235, February, 1986. 2 fig, 2 tab, 4 ref.

Descriptors: *Total organic carbon, *Water analysis, *Nitrogen, *Pyrolysis, *Gas chromatography, *Mass spectrometry, Chemical analysis.

An apparatus containing a pyrolysis unit, a gas chromstograph and a quadrupole mass spectrometer was assembled for simultaneous determination of total organic carbon (TOC) and total nitrogen (TN) in water. The mass spectra of carbon and nitrogen species after pyrolysis, the precision, analytical curves and detection limits of the apparatus and analytical results of the water samples are described. Results agreed well with those obtained by a combustion-infrared method for TOC and a combustion-coulometric method for TN. (Author's abstract)
W87-02417

INVESTIGATIONS INTO THE SCOPE AND LIMITATIONS OF THE BISMUTH ACTIVE SUBSTANCES PROCEDURE (WICKBOLD) FOR THE DETERMINATION OF NONIONIC SURFACTANTS IN ENVIRONMENTAL SAMPLES,
Unilever Research Port Sunlight Lab. (England).
J. Waters, T. Garrigan, and A. M. Paulson.
Water Research WATRAG, Vol. 20, No. 2, p 247-253, February, 1986. 1 fig, 5 tab, 9 ref.

Descriptors: *Water analysis, *Bismuth, *Nonionic surfactants, Sample preparation, Sewage, Wastewater treatment, Raw wastewater, Effluents, Solvents, Cleanup, Biodegradation.

The Wickbold bismuth active substances (BiAS) has been officially adopted in Europe as the means for determining alkoxylated nonionic surfactants in biodegradation test liquors. The scope and limitations of this procedure are demonstrated in a series of experiments in which the effect of procedural variables such as sample pretreatment, number and duration of solvent sublation steps and ion-exhange clean-up of BiAS extracts before analysis is determined. BiAS procedures in which variables are not suitably chosen can result in BiAS levels being more underestimated in raw sewage samples than in samples of corresponding effluents. This could lead to the perception that nonionic surfactant removal by the sewage treatment process is less efficient than it actually is in practice. It is recommended that when BiAS procedures are employed, whole samples should be used and the procedure should include four ten-minute sublation steps and a cation/anion exchange cleanup of the sublation extracts. (Author's abstract)
W87-02419

PRECONCENTRATION OF COPPER IN WATER SAMPLES WITH 2-MERCAPTOBENZOTHIAZOLE ON NAPHTHALENE,
Fukui Univ. (Japan). Faculty of Engineering.
M. Satake, K. Ishida, B. K. Puri, and S. Usami.
Analytical Chemistry ANCHAM, Vol. 58, No. 16, p 2502-2504, October 1986. 3 tab, 9 ref.

Descriptors: *Copper, *Chemical analysis, *Water analysis, *Pollutant identification, *2-Mercaptobenzothiazole, *Naphthalene, Water sampling, Hydrogen ion concentration, Absorption.

A solid chelating material, 2-mercaptobenzothiazole (2-MBT), on naphthalene provides a rapid and highly selective means of preconcentration of copper from natural water samples. Copper is quantitatively retained on 2-MBT-naphthalene in the pH range 5.5-7.5 and at a flow rate of 5 mL/min. The metal complex-naphthalene is dissolved from the column with 10 ml of n-butylamine-dimethylformamide (5:100 v/v) and measured by an atomic absorption spectrophotometer at 324.7 nanometers. Beer's law is obeyed in the concentration range 2.0-80.0 micrograms of copper in 10 ml of the final solution. Ten replicate analyses of 40 micrograms of copper gave a mean absorbance of 0.190 with a relative standard deviation of 1.0%. The sensitivity for 1% absorption is 0.093 micrograms/ml (0.133 micrograms/ml for the direct AAS method from the aqueous solution). The method has been employed for the determination of copper in various standard reference materials and natural water samples. (Author's abstract)
W87-02421

RIVERS OF THE AMAZON BASIN. I. TRIBUTARIES OF THE RIO NEGRO, (RIOS DA BACIA AMAZONICA. I. AFLUENTES DO RIO NEGRO),
Instituto Nacional de Pesquisas da Amazonia, Manaus (Brazil).
For primary bibliographic entry see Field 5B.
W87-02431

EXPERIENCES WITH ICP MASS SPECTROMETRY IN WATER ANALYSIS, (ERFAHRUNGEN MIT DER ICP MASSENSPEKTROMETRIE IN DER WASSERANALYTIK),
Ruhrverband, Essen (Germany, F.R.). Chemisches und Biologisches Lab.
F. Dietz.
Fresenius' Zeitschrift fuer Analytische Chemie ZACFAU, Vol. 324, p 222-223, June 1986. 1 fig.

Descriptors: *Mass spectrometry, *Water analysis, *Chemical analysis, Errors, Metals, Elemental analysis.

ICP mass spectrometry (ICP = inductively coupled plasma) is a promising analytical method for elemental analysis of environmental samples. A survey-type measurement takes about two minutes and yields a spectrum of masses that can be used for the elemental analysis. The detection limit for most elements is in the 1 microgram/liter range. Still greater sensitivity is found for elements 80 atomic mass units or greater, which could facilitate analysis for Ag, Bi, Cd, Hg, Pb, and other environmentally important metals. Some problems remain: notably, the water (in which the sample is introduced via spraying, and which may contain air) can produce spurious lines in the spectrum, which could be falsely identified with some of the lighter elements (thus,the true detection limits for these elements are 1-3 micrograms/liter). The argon plasma, likewise, introduces argon-containing impurities, which show up in the mass lines for some elements. (Airone-PTT)
W87-02432

DETERMINATION OF ORGANIC HETEROATOMS IN WATERS, (ZUR BESTIMMUNG ORGANISCH GEBUNDENER HETEROATOME IN GEWAESSERN),
Technische Univ. Muenchen (Germany, F.R.). Inst. fuer Wasserchemie und Chemische Balneologie.
For primary bibliographic entry see Field 2K.
W87-02433

CHEMICAL AND BIOCHEMICAL OXYGEN DEMAND (COD,BOD) AS KEY PARAMETERS FOR THE SUMMARIZING ASSESSMENT OF ORGANIC WATER CONTAMINANTS, (CHEMISCHER UND BIOCHEMISCHER SAUERSTOFFBEDARF (CSB,BSB) ALS SCHLUESSELPARAMETER FUER DIE SUMMARISCHE BEURTEILUNG ORGANISCHER WASSERBELASTUNGSSTOFFE),
Stuttgart Univ. (Germany, F.R.). Inst. fuer Siedlungswasserbau, Wasserguete- und Abfallwirtschaft.
R. Wagner.
Fresenius' Zeitschrift fuer Analytische Chemie ZACFAU, Vol. 324, p 224-225, June 1986.

Descriptors: *Biological wastewater, treatment, *Biological oxygen demand, *Chemical oxygen demand, Oxygen, Wastewater treatment, Chemical reduction, Microbial degradation, Water analysis, Water pollution.

Some approved techniques for measuring chemical and biological oxygen demand are discussed, and precautions are indicated that are necessary to ensure correct results. The oxygen demand data are important in biological treatment of wastewater, and can be used to estimate the practicality of such treatment in a particular instance. (Airone-PTT)
W87-02434

TOTAL AND GROUP PARAMETERS AS A MEASURE FOR THE CONTAMINATION OF WATERS WITH ORGANIC SUBSTANCES ILLUSTRATED BY EXAMPLE OF THE RIVER RHINE, (SUMMEN-UND GRUPPENPARA-

METER ALS MASS FUER DIE BELASTUNG EINES GEWAESSERS MIT ORGANISCHEN STOFFEN, DARGESTELLT AM BEISPIEL DES RHEINS),
Karlsruhe Univ. (Germany, F.R.). Lehrstuhl fuer Wasserchemie.
H. Sontheimer, and W. Kuehn.
Fresenius' Zeitschrift fuer Analytische Chemie ZACFAU, Vol. 324, p 225, June 1986.

Descriptors: *Rhine River, *Water quality, *Water analysis, Surface water, Wastewater, Water pollution control, Chemical oxygen demand, Dissolved organic carbon.

The migration of numerous organic substances into groundwater and surface water results in loss of water quality, and measurement of the magnitude of this loss is among the most important tasks of water analysis. Two parameters are especially useful: dissolved organic carbon (DOC) and chemical oxygen demand (COD). Their ratio COD/DOC also provides information about the general structure of the sample solute contents. Group parameters (heteroatoms, halogens, UV absorption) are achieving greater importance in such analyses. Investigations of this type on rivers such as the Rhine have produced practical accounts of the development of water quality and of the effects of various purification procedures. (Airone-PTT)
W87-02435

TRACE DETERMINATION OF MOLYBDENUM AND VANADIUM IN NATURAL WATERS BY MEANS OF ATOMIC SPECTROSCOPY (AAS, ICP-OES) AFTER PRECONCENTRATION,
Institut fuer Spektrochemie und Angewandte Spektroskopie, Dortmund (Germany, F.R.).
For primary bibliographic entry see Field 2K.
W87-02436

INVESTIGATION AND REMEDIATION OF A MINERAL SPIRIT PRODUCT LOSS IN A SHALLOW UNCONFINED AQUIFER,
O'Brien and Gere Engineers, Inc., Syracuse, NY.
For primary bibliographic entry see Field 5F.
W87-02472

UNDERSTANDING WATER CHEMISTRY: THE NEED FOR IMPROVED ANALYSES IN REVERSE OSMOSIS PLANT OPERATIONS,
Goodrich (B.F.) Co., Beltaville, MD. Specialty Polymers and Chemicals Div.
For primary bibliographic entry see Field 5D.
W87-02491

INVESTIGATING ERROR IN CALCULATION OF AREAL CHLOROPHYLL A CONCENTRATION IN TWIN LAKES, COLORADO,
Bureau of Reclamation, Denver, CO. Engineering and Research Center.
For primary bibliographic entry see Field 2H.
W87-02547

5B. Sources Of Pollution

BIOTRANSFORMATIONS OF CHLOROGUAIACOLS, CHLOROCATECHOLS, AND CHLOROVERATROLES IN SEDIMENTS,
Swedish Environmental Research Inst., Stockholm.
For primary bibliographic entry see Field 5C.
W87-01784

ETHYLENE DIBROMIDE MINERALIZATION IN SOILS UNDER AEROBIC CONDITIONS,
Connecticut Agricultural Experiment Station, New Haven. Dept. of Soil and Water.
J. J. Pignatello.
Applied and Environmental Microbiology AEMIDF, Vol. 51, No. 3, p 588-592, March 1986. 3 tab, 22 ref.

Descriptors: *Biodegradation, *Path of pollutants, *Fate of pollutants, *Anaerobic conditions, *Ethylene dibromide, *Mineralization, *Soil bacteria, *Soil contamination, Isotope studies, Groundwater, Groundwater bacteria, Decontamination, Bacterial physiology.

1,2-Dibromoethane (EDB) was shown to be degraded aerobically by microorganisms in two types of surface soils from an EDB-contaminated groundwater discharge area. At initial concentrations of 6 to 8 microgram/liter (ug/l), EDB was degraded within a few days to near or below the detection limit of 0.02 ug/l. At 15-18 mg/l, degradation was slower. Bromide ion release at the higher concentrations was 1.4 + or - 0.3 and 2.1 + or - 0.2 molar equivalents for two soils. Experiments with (14C)EDB showed that EDB was converted to approximately equal amounts of CO2 and apparent cellular carbon; only small amounts of added 14C were not attributable to these products or unreacted EDB. These results are encouraging, because they indicate that groundwater bacteria may hasten the removal of EDB from contaminated aerobic groundwater supplies. (Author's abstract)
W87-01785

ATTACHED AND FREE-FLOATING BACTERIOPLANKTON IN HOWE SOUND, BRITISH COLUMBIA, A COASTAL MARINE FJORD-EMBAYMENT,
Simon Fraser Univ., Burnaby (British Columbia). Dept. of Biological Sciences.
For primary bibliographic entry see Field 2L.
W87-01787

CHEMISTRY OF LAKE HOVVATN, NORWAY, FOLLOWING LIMING AND REACIDIFICATION,
Norsk Inst. for Vannforskning, Oslo.
R. F. Wright.
Canadian Journal of Fisheries and Aquatic Sciences CJFSBX, Vol. 42, No. 6, p 1102-1113, June 1985. 9 fig, 2 tab, 35 ref.

Descriptors: *Lake Hovvatn, *Liming, *Acidification, *Acid rain, Limestone, Norway, Aluminum, Calcium, Alkalinity, Hydrogen ion concentration, Pollen Lake, Hydrologic models, Flushing, Ice cover.

Hovvatn, a 1-sq km, chronically acidified lake in southernmost Norway, was treated in March 1981 with 200 metric tons of powdered limestone. An additional 40 metric tons was added to a 0.046-sq km pond (Pollen) draining into Hovvatn. At ice-out, pH rose from 4.4 to 6.3 (Hovvatn) and 7.5 (Pollen), Ca and alkalinity increased, and total Al decreased by about 120 microgram/liter. The amount of limestone dissolved, as calculated from lake Ca budgets, was 50% after 3.5 yr in Hovvatn and 25% in Pollen. A greater fraction dissolved at Hovvatn because the limestone lay in the active surf zone. In Pollen limestone that was not dissolved at ice-out formed a layer on the sediment surface from which only minimal dissolution occurred. Hovvatn and Pollen reacidified to pH 4.9 and 5.5, respectively, 3 yr after liming. A simple flushing model describes the reacidification of Pollen, but in Hovvatn, dissolution of additional limestone during the 3.5 yr since liming has considerably slowed reacidification. (Author's abstract)
W87-01791

INFLUENCE OF FISH-ZOOPLANKTON-PHYTOPLANKTON INTERACTIONS ON THE RESULTS OF SELENIUM TOXICITY EXPERIMENTS WITHIN LARGE ENCLOSURES,
Department of Fisheries and Oceans, Winnipeg (Manitoba). Freshwater Inst.
For primary bibliographic entry see Field 5C.
W87-01792

ORGANIC NITROGEN COMPOUNDS IN ATMOSPHERIC PRECIPITATION: THEIR CHEMISTRY AND AVAILABILITY TO PHYTOPLANKTON,
Department of Scientific and Industrial Research, Taupo (New Zealand). Div. of Marine and Freshwater Sciences.
M. H. Timperly, R. J. Vigor-Brown, M. Kawashima, and M. Ishigami.
Canadian Journal of Fisheries and Aquatic Sciences CJFSBX, Vol. 42, No. 6, p 1171-1177, June 1985. 5 fig, 3 tab, 53 ref.

Descriptors: *Urea, *Precipitation, *Atmospheric chemistry, *New Zealand, *Japan, *Dissolved organic nitrogen, *Phytoplankton, Lake Biwa, Chlorophyta, Airborne particulates, Soil, Plant growth, Uric acid, Amino acids, Axenic culture, Nutrition.

Urea accounted for 30, 36, and 56%, respectively, of the water-soluble organic N (DON) compounds deposited from the atmosphere at two sites in New Zealand and one site in Japan. The other DON compounds were not identified, but they were all of low molecular size, apparently anionic, and did not include detectable quantities of amino acids or uric acid. In axenic culture, Chlorella spp grew successfully using DON from New Zealand as the only source of N; Pediastrum biwae, a phytoplankter endemic to Lake Biwa in Japan, achieved successful growth using DON separated from Japanese precipitation. Ammonium-N and DON were deposited from the atmosphere in the absence of rain or snow, and the authors suggest that particulate matter, possibly soil, is a major source of these N compounds in atmospheric precipitation. (Author's abstract)
W87-01793

EVIDENCE OF CONTAMINANT LOADING TO LAKE ONTARIO FROM THE NIAGARA RIVER,
National Water Research Inst., Burlington (Ontario). Aquatic Physics and Systems Div.
A. H. El-Shaarawi, S. R. Esterby, N. D. Warry, and K. W. Kuntz.
Canadian Journal of Fisheries and Aquatic Sciences CJFSBX, Vol. 42, No. 7, p 1278-1289, July 1985. 5 fig, 6 tab, 15 ref.

Descriptors: *Water pollution sources, *Lake Ontario, *Niagara River, *Pollution, *Organic compounds, *Metals, *Suspended sediments, Raw water, Statistics, Pollutant sources, Canada.

The hypothesis that the concentrations of pollutants are the same throughout the length of the Niagara River, against the alternative that they are higher in the lower river, was examined using three sets of data: (1) Ontario Ministry of Environment (MOE) results for organic substances in raw drinking water (1978-84); (2) MOE transect data for metals in water (1981); and (3) Environment Canada data on organic substances in large-volume water samples and suspended sediments (1981). The designs of the studies dictated different statistical procedures for each set, with nonparametric procedures based on ranking being used for sets 1 and 3, and normal theory methods for set 2. Furthermore, both univariate and multivariate procedures were used for set 3. Despite the considerable number of nondetections from these data, it was still possible to make quantitative comparative statements, with the degree of uncertainty providing the quantitative component. In each study, a number of substances were shown to be in higher concentrations in the lower river than in the upper river, and by examining all substances of set 3 simultaneously, locations in the lower river were shown to be more similar to each other as were locations in the upper river. (Author's abstract)
W87-01798

HISTORICAL RELATIONSHIPS BETWEEN PHOSPORUS LOADING AND BIOGENIC SILICA ACCUMULATION IN BAY OF QUINTE SEDIMENTS,
Michigan Univ., Ann Arbor. Great Lakes Research Div.
For primary bibliographic entry see Field 5C.
W87-01803

BENTHIC MACROINVERTEBRATES MODIFY COPPER AND ZINC PARTITIONING IN FRESHWATER-SEDIMENT MICROCOSMS,

Toronto Univ. (Ontario). Inst. for Environmental Studies.
For primary bibliographic entry see Field 2H.
W87-01804

ORGANIC MATTER IN THE GULF OF ST. LAWRENCE IN WINTER,
Bedford Inst. of Oceanography, Dartmouth (Nova Scotia).
For primary bibliographic entry see Field 2L.
W87-01809

INFLUENCE OF SNOWCOVER DEVELOPMENT AND GROUND FREEZING ON CATION LOSS FROM A WETLAND WATERSHED DURING SPRING RUNOFF,
Trent Univ., Peterborough (Ontario). Watershed Ecosystems Program.
D. C. Pierson, and C. H. Taylor.
Canadian Journal of Fisheries and Aquatic Sciences CJFSBX, Vol. 42, No. 12, p 1979-1985, December 1985. 4 fig, 1 tab, 19 ref.

Descriptors: *Acid precipitation, *Snowmelt, *Hydrogen ion concentration, *Runoff, *Seasonal distribution, *Ontario, *Snowpack, *Calcium, *Magnesium, *Sodium, *Ions, *Potassium, Soil frost, Streams, Canada.

Cation and water export during spring runoff were monitored from a small wetland watershed in south-central Ontario (Canada) for two years with very different sequences of snowpack development. In 1977, a persistent snow cover developed by 1 December, and snow accumulation was near normal for this region. In 1980, persistent snow cover did not develop until mid-January, and the final snowpack was well below average. Between years, major differences in the timing of ion export were found for Ca, Mg, and Na, ions which appear to be associated with watershed's soils. Conversely, K, a cation not as strongly associated with soil ion sources, showed temporal patterns of export that were similar during both years. It is hypothesized that concrete soil frost, which developed in 1980 as a consequence of the late-developing snow cover, strongly influenced the timing of ion export by isolating early spring runoff from the watershed's soils. Streamwater hydrogen ion concentrations decreased rapidly during the first week of spring runoff in 1980, indicating that hydrogen ion export was increased by a similar mechanism. In poorly-buffered systems, the formation of concrete soil frost may lead to significant increases in hydrogen ion export during spring snowmelt. (Author's abstract)
W87-01815

ACIDIFICATION AND TOXICITY OF METALS TO AQUATIC BIOTA,
Institut National de la Recherche Scientifique, Sainte-Foy (Quebec).
For primary bibliographic entry see Field 5C.
W87-01819

RESPONSE OF RADIOACTIVE TRACE METALS TO ACID-BASE TITRATIONS IN CONTROLLED EXPERIMENTAL ECOSYSTEMS: EVALUATION OF TRANSPORT PARAMETERS FOR APPLICATION TO WHOLE-LAKE RADIOTRACER EXPERIMENTS,
Lamont-Doherty Geological Observatory, Palisades, NY.
P. H. Santschi, U. P. Nyffeler, R. F. Anderson, S. L. Schiff, and P. O'Hara.
Canadian Journal of Fisheries and Aquatic Sciences CJFSBX, Vol. 43, No. 1, p 60-77, January 1986. 11 fig, 9 tab, 19 ref. NSF Grant DEB 80-17639.

Descriptors: *Path of pollutants, *Acidity, *Radioactive tracers, *Trace metals, *Metal cycling, *Lakes, *Enclosures, *Titrations, *Sedimentation, Experimental Lakes Area, Ontario, Metal removal mechanisms, Manganese, Cobalt, Zinc, Hydrogen ion concentration, Antimony, Iron, Selenium, Chromium, Silver, Mercury, Isotope studies, Calcium carbonate, Transport, Canada.

Radiotracer experiments were carried out in 20 enclosures located in two lakes at the Experimental Lakes Area (ELA), northwestern Ontario (Canada), to study pathways of trace metal removal from the water column of shallow lakes. Two removal mechanisms were characterized: (1) sorption to and subsequent transport with falling particles; and (2) direct adsorption to surface sediments. The approach employed independent measurements of the kinetics of radiotracer sorption, fluxes and concentrations for particles, particle settling velocities, and the 'equivalent stagnant boundary film.' Radiotracer results enabled testing of the senstivity of the tracer removal rates on these rate-determining processes using a numerical transport model. Acid titrations of whole ecosystems revealed that some trace metals (eg, Mn, Co, and Zn) can diffuse back to the water column as the pH is lowered from 6.5 to 4.8 after 18 days, whereas others remain tightly bound (eg, Sn, Fe, Se, Cr, Ag, and Hg isotopes). Subsequent CaCO3 additions to restore the pH to its original value brought back the initial removal conditions for acid-sensitive radiotracers. Transport parameters for particle-related pathways or diffuse pathways across the sediment-water interface obtained from enclosure experiments were used to predict the removal rates of 'particle-reactive' 60Co and the 'diffusive' pathway tracer 134Cs observed in earlier experiments where radiotracers were added to whole lakes or larger enclosures. (Author's abstract)
W87-01821

BIOGEOGRAPHIC INFLUENCES ON FISH SPECIES COMPOSITION OF NORTHERN WISCONSIN LAKES WITH APPLICATIONS FOR LAKE ACIDIFICATION STUDIES,
Ohio State Univ., Columbus. Dept. of Zoology.
For primary bibliographic entry see Field 5C.
W87-01824

MODIFICATION OF BIOACCUMULATION OF SELENIUM BY MYTILUS EDULIS IN THE PRESENCE OF ORGANIC AND INORGANIC MERCURY, (MODIFICATION DE LA BIOACCUMULATION DU SELENIUM CHEZ MYTILUS EDULIS EN PRESENCE DU MERCURE ORGANIQUE ET INORGANIQUE),
Institut National de la Recherche Scientifique, Rimouski (Quebec).
For primary bibliographic entry see Field 5C.
W87-01827

ACCLIMATION-INDUCED CHANGE IN TOXICITY OF ALUMINUM TO RAINBOW TROUT (SALMO GAIRDNERI),
Guelph Univ. (Ontario). Dept. of Zoology.
For primary bibliographic entry see Field 5C.
W87-01829

SIMULATION OF TURBULENT DISPERSION USING A SIMPLE RANDOM MODEL OF THE FLOW FIELD,
Heriot-Watt Univ., Edinburgh (Scotland). Dept. of Offshore Engineering.
A. D. Jenkins.
Applied Mathematical Modelling AMMODL, Vol. 9, No. 4, p 239-245, August 1985. 5 fig, 19 ref.

Descriptors: *Simulation analysis, *Path of pollutants, *Turbulent flow, *Model studies, Flow profiles, *Waves, Computer models, Mathematical studies, Mathematical analysis.

A method is devised to simulate the movement and spreading of a patch of contaminant in two-dimensional turbulent flow. The turbulent motion is exponentially divided into components of differing wave number, adjacent components being made to have correlation times differing by a factor of two. The turbulent motion is then reconstructed by replacing each component with a sinusoidal advection field having a randomly directed wave number. Contaminant particles are advected by each of the reconstructed components, the smallest scale components being applied first. A computer simulation was performed using a Kolmogorov k to the negative (5/3) power of turbulent energy spectrum. Batchelor's sigma (alpha) t raised to the (3/2) law for the spreading of a contaminant patch was reproduced, approximately, as was Richardson's non-Gaussian asymptotic form of the distance-neighbor function. (Author's abstract)
W87-01832

CONTINUOUS SOURCE OF TIDAL FLOW: A NUMERICAL STUDY OF THE TRANSPORT EQUATION,
Hong Kong Univ. Dept. of Civil Engineering.
C. W. Li, and J. H. W. Lee.
Applied Mathematical Modelling AMMODL, Vol. 9, No. 4, p 281-288, August 1985. 5 figs, 11 ref, 2 appends.

Descriptors: *Path of pollutants, *Estuaries, *Numerical analysis, *Mathematical models, Continuous flow, Mathematical studies, Model studies, Tides, Transport equation, Flow velocity, Fourier analysis, Mathematical analysis.

A detailed comparative numerical study of a continuous pollutant source discharging in a tidal flow is performed. The advective term in the one-dimensional transport equation consists of a constant freshwater velocity and an isotropic oscillating component. Various finite element solutions are investigated. Compared to the analytical solution of the dynamic steady state concentration, the numerical results for typical estuarine conditions indicate the superiority of the collocation method with Hermite basis functions. An extended Fourier series analysis that accounts for the source condition is developed to explain the numerical behavior of the different schemes. (Author's abstract)
W87-01834

LAKE ACIDIFICATION AS A LIMITING FACTOR IN THE DISTRIBUTION OF THE FRESHWATER AMPHIPOD HYALELLA AZTECA,
Guelph Univ. (Ontario). Dept. of Zoology.
M. Stephenson, and G. L. Mackie.
Canadian Journal of Fisheries and Aquatic Sciences CJFSBX, Vol. 43, No. 2, p 288-292, February 1986. 4 fig, 20 ref. NSERC(Canada) Strategic Grant G0918.

Descriptors: *Amphipods, *Lakes, *Acid rain, *Acidification, *Ontario, *Bioindicators, Hydrogen ion concentration, Seasonal distribution, Canada.

The distribution of Hyalella azteca in 79 Ontario (Canada) lakes suggests that its absence may be a good indicator of lake acidification. The species was present in 69/71 nonacidified lakes, and absent in 8/8 lakes that either are now or were recently considered acidified. Bioassay data indicate a 96-hr LC50 of pH 4.4 and a 10-day threshold LC50 of pH 4.5 for H azteca in a natural surface water. H azteca is extremely rare in Plastic Lake, which undergoes severe short-term acidification in spring, and recruitment is delayed 2 wk in Heeney Lake, which undergoes a similar short-term acidification. In Dickie, Harp, Red Chalk, and Blue Chalk Lakes, where springtime pH depressions below pH 4.7 were not recorded, H azteca is abundant. (Author's abstract)
W87-01847

DOES ALGAL-BACTERIAL PHOSPHORUS PARTITIONING VARY AMONG LAKES. A COMPARATIVE STUDY OF ORTHOPHOSPHATE UPTAKE AND ALKALINE PHOSPHATASE ACTIVITY IN FRESHWATER,
Montreal Univ. (Quebec). Dept. of Biological Sciences.
For primary bibliographic entry see Field 2H.
W87-01848

PHOSPHATE UPTAKE BY MICROORGANISMS IN LAKE WATER: DEVIATIONS FROM SIMPLE MICHAELIS-MENTEN KINETICS,
National Oceanic and Atmospheric Administration, Ann Arbor, MI. Great Lakes Environmental Research Lab.

For primary bibliographic entry see Field 2H.
W87-01849

LIGHT HISTORY, PHOSPHORUS STATUS, AND THE OCCURRENCE OF LIGHT STIMULATION OR INHIBITION OF PHOSPHATE UPTAKE IN LAKE SUPERIOR PHYTOPLANKTON AND BACTERIA,
Scarborough Coll., Westhill (Ontario). Life Sciences Div.
For primary bibliographic entry see Field 2H.
W87-01850

DYNAMICS OF LAKE MICHIGAN NATURAL PHYTOPLANKTON COMMUNITIES IN CONTINUOUS CULTURES ALONG A SI:P LOADING GRADIENT,
Michigan Univ., Ann Arbor. Div. of Biological Sciences.
For primary bibliographic entry see Field 2H.
W87-01851

RADIOTRACER STUDY OF PHOSPHORUS CYCLING IN A EUTROPHIC CANADIAN SHIELD LAKE, LAKE 227, NORTHWESTERN ONTARIO,
Department of Fisheries and Oceans, Winnipeg (Manitoba). Freshwater Inst.
For primary bibliographic entry see Field 2H.
W87-01852

NUTRIENT STATUS OF PHYTOPLANKTON BLOOMS IN NORWEGIAN WATERS AND ALGAL STRATEGIES FOR NUTRIENT COMPETITION,
Trondheim Univ. (Norway). Biological Station.
For primary bibliographic entry see Field 2H.
W87-01853

NUTRIENT ENRICHMENT STUDIES IN A COASTAL PLAIN ESTUARY: PHYTOPLANKTON GROWTH IN LARGE-SCALE, CONTINUOUS CULTURES,
Maryland Univ., Solomons. Chesapeake Biological Lab.
For primary bibliographic entry see Field 5A.
W87-01854

PHOSPHORUS ENRICHMENT, SILICA UTILIZATION, AND BIOGEOCHEMICAL SILICA DEPLETION IN THE GREAT LAKES,
Michigan Univ., Ann Arbor. Great Lakes Research Div.
For primary bibliographic entry see Field 2H.
W87-01855

INFLUENCE OF SALMONINE PREDATION AND WEATHER ON LONG-TERM WATER QUALITY TRENDS IN LAKE MICHIGAN,
National Oceanic and Atmospheric Administration, Ann Arbor, MI. Great Lakes Environmental Research Lab.
D. Scavia, G. L. Fahnenstiel, M. S. Evans, D. J. Jude, and J. T. Lehman.
Canadian Journal of Fisheries and Aquatic Sciences CJFSBX, Vol. 43, No. 2, p 435-443, February 1986. 3 fig, 1 tab, 65 ref. NSF Grant DEB81-16428.

Descriptors: *Bioindicators, *Water quality, *Lake Michigan, *Long-term trends, *Phosphorus, *Chlorophyll a, *Salmonines, Suspended sediments, Alewife, Fish stocking, Fish management, Calanoid copepods, Grazing, Secchi disks, Transparency, Weather, Epilimnion, Ice cover, Seasonal variation.

Trends in Lake Michigan water quality over the period 1975-84 appear to reflect reduced nutrient loadings, as indicated by gradual declines in spring total phosphorus (TP) and summer epilimnetic chlorophyll a (Chl a). Deviations from these trends in 1977 and 1983-84 apparently were caused by abiotic and biotic factors, respectively. Prolonged ice cover during 1977 decreased sediment resuspension, resulting in lower TP, reduced Chl a levels, and increased water clarity. A similar dramatic result occurred in 1983 and to a lesser extent in 1984, but via a different mechanism. Burgeoning populations of stocked salmonines reduced populations of the planktivorous alewife (Alosa pseudoharengus), which allowed large Daphnia to flourish. Because the Daphnia are more voracious and nonselective grazers than the formerly dominant calanoid copepods, they reduced seston concentrations, causing dramatic increases in Secchi disk transparency. These exceptions demonstrate the far-reaching consequences that unusual weather conditions and fish management practices may have on water quality indicators. (Author's abstract)
W87-01856

LIMNETIC ZOOPLANKTON ASSEMBLAGES IN ATLANTIC CANADA WITH SPECIAL REFERENCE TO ACIDIFICATION,
Waterloo Univ. (Ontario). Dept. of Biology.
J. C. H. Carter, W. D. Taylor, R. Chengalath, and D. A. Scruton.
Canadian Journal of Fisheries and Aquatic Sciences CJFSBX, Vol. 43, No. 2, p 444-456, February 1986. 8 fig, 5 tab, 39 ref.

Descriptors: *Rotifers, *Crustacea, *Zooplankton, *Acidification, *Lakes, *Lake morphometry, Labrador, New Brunswick, Nova Scotia, Newfoundland, Canada, Clustering, Buffering capacity, Multiple discriminant analysis, Alkalinity, Hydrogen ion concentration, Calcium, Fog, Precipitation, Air pollution.

Crustacean and rotifer plankton assemblages of 93 lakes in Labrador, 107 in Newfoundland, and 142 in New Brunswick-Nova Scotia were investigated for evidence of correlations with lake morphometric, chemical, or biological factors. Labrador assemblages were almost completely lacking in identifiable structure. Newfoundland species clustered into two groups of different body size, suggesting the influence of fish predation. Only one species in Labrador and Newfoundland was significantly correlated with a derived factor related to buffering capacity. New Brunswick-Nova Scotia species clustered into two groups, one featuring significant positive and the other significant negative correlations with the buffering factor. From this, the authors conclude that acidification is having an impact on the limnetic zooplankton of these two provinces. Multiple discriminant analysis demonstrated that New Brunswick-Nova Scotia lakes differing in their buffering capacity were also distinct in zooplankton compostion. Lakes with low factor scores (low pH, alkalinity, and Ca) were mainly located in the Bay of Fundy region, which has above-average fog and precipitation and lies within the summer air flow carrying pollutants from the south. (Author's abstract)
W87-01857

EXTENDING THE USE OF CERTIFIED REFERENCE SEDIMENTS FOR ASSESSMENT OF ACCURACY IN DETERMINATIONS OF TRACE METALS,
Department of the Environment, Victoria (British Columbia). Inst. of Ocean Sciences.
R. W. MacDonald, and M. C. O'Brien.
Analytica Chimica Acta ACACAM, Vol. 177, p 81-91, November 31, 1985. 2 fig, 19 ref.

Descriptors: *Sediments. *Environmental effects, *Model studies, Reference sediments, Youden pairs, Particle size.

Straightforward analysis for components in a single certified reference sediment is of limited use for assessing the accuracy of environmental determinations. A systematic approach requires mixing of certified a sediments, one with another and with environmental samples, and the preparation of secondary reference material by the laboratory. Use of Youden pairs, reference material embedded in samples and linear models should enable valid accuracy statements to be made based on well known statistical concepts. For assessing accuracy, reference sediments which are matched in particle size, and are end-members for components or sediment types are most useful. (Author's abstract)
W87-01862

DETERMINATION OF ACETIC, FORMIC, AND PROPANOIC ACIDS IN RAIN WATER BY REVERSE-PHASE HIGH-PERFORMANCE LIQUID CHROMATOGRAPHY,
Commonwealth Scientific and Industrial Research Organization, Aspendale (Australia). Div. of Atmospheric Research.
R. W. Gillett, and G. P. Ayers.
Analytica Chimica Acta ACACAM, Vol. 177, p 273-277, November 31, 1985. 3 fig, 1 tab, 16 ref.

Descriptors: *Acid rain, *Wateranalysis, *Organic acids, *Chromatography, Australia, Northern Territory, Detection limits, Nitrates, Nitrites, Methanesulfonic acid.

In recent years, the considerable interest in the composition of precipitation in remote areas has led to the need to determine natural and anthropogenic acid components in the atmosphere. In Australia, the Northern Territory is one sparsely populated region where organic acids have been reported, and in order to establish the origin and distribution of these organic acids, a reliable and well documented detection technique is required. The system used consisted of a Laboratory Data Control chromatography control module, Constametric III pump, Spectro-Monitor D variable-wavelength detector set at 210 nm and a Rheodyne 7125 injector. Methanesulfonic acid alone in the mobile phase caused co-elution of nitrite with acetic acid, and also nitrate with propanoic acid. This was overcome by adding a small amount of n-octylamine. The three organic acids, as well as nitrite and nitrate, are separated on a Spherisorb S3-ODS2 column with a methanseulfonic acid mobile phase containing n-octylamine for ion-pairing, after concentration on a Vydac column. Retention times are <10 min. Detection limits are in the range 0.00000045-0.0000015 M for 1-ml samples. (Peters-PTT)
W87-01866

ISOLATION, IDENTIFICATION, AND GROWTH OF WELL-WATER BACTERIA,
Arizona Univ., Tucson. Dept. of Microbiology and Immunology.
For primary bibliographic entry see Field 5A.
W87-01869

ALDICARB STUDIES IN GROUND WATERS FROM FLORIDA CITRUS GROVES AND THEIR RELATION TO GROUND-WATER PROTECTION,
Florida Inst. of Tech., Melbourne. Dept. of Environmental Sciences and Engineering.
F. E. Dierberg, and C. J. Given.
Ground Water GRWAAP, Vol. 24, No. 1, p 16-22, January-February, 1986. 2 tab, 18 ref. DOI Project 371003.

Descriptors: *Citrus fruits, *Water pollution sources, *Insecticides, *Fate of pollutants, *Pollutants, *Subsoil, Aldicarb, Indian River County, Florida, Degradation rates, Hydrologic parameters.

The disappearance of aldicarb (2-methyl-2(methylthio) propionaldehyde O-(methylcarbamoyl) oxime) and its two toxic degradation products, aldicarb sulfoxide and aldicarb sulfone, were measured in laboratory studies using ground waters and subsoils collected from citrus groves in Indian River County, Florida, and incubated under controlled conditions which best represented the in situ environment. The half-life times for the disappearance of aldicarb and its two oxidized sulfur derivatives in groundwater-saturated subsoils ranged from 10-26 days. Based on the degradation rates found in this study, hydrologic parameters obtained for Indian River County subsoils, and amounts of total toxic residue reported entering Florida ground waters, it was estimated that toxic residues in aldicarb-contaminated ground waters in Indian River County would migrate only short distances (0.3-5.2 m) before conversion of toxic

residues to nontoxic residues was complete. (Author's abstract)
W87-01871

PARAMETER IDENTIFICATION OF A GROUND-WATER CONTAMINANT TRANSPORT MODEL,
Woodward-Clyde Consultants, Walnut Creek, CA.
E. W. Strecker, and W.-S. Chu.
Ground Water GRWAAP, Vol. 24, No. 1, p 56-62, January-February 1986. 4 fig, 3 tab, 18 ref. DOI Grant 4-FG-93-00010.

Descriptors: *Mathematical models, *Path of pollutants, *Algorithms, *Pollutants, *Groundwater movement, Aquifers, Mathematical studies, Quadratic programming, Field application.

Test reports are presented of combining a parameter identification (PI) algorithm with a groundwater flow and contaminant transport model. The PI algorithm is generic, and it can be coupled with any specific model. The ground-water model selected for this study was developed at the United States Geological Survey (USGS) by Konikow and Bredehoeft (1978), and is referred to as the USGS Method of Characteristics (USGS-MOC) code. The PI procedure can be used to estimate selected model parameters from limited observations by quadratic programming. The code combining the PI procedure and the USGS-MOC model has been tested by two numerical examples from a hypothetical aquifer. The test results show that the proposed algorithm can identify transmissivity and dispersivity accurately under ideal situations. The effects of using a simple characterization of the aquifer onparameter estimation and model are shown. Because of the improved efficiency in model calibration, extended application to field conditions is encouraged. However, it is cautioned that the interested users should be aware of the difficulties in field applications of PI, and it is recommended that sound engineering and scientific judgements are always needed in the use of the proposed, or any other PI method. (Peters-PTT)
W87-01876

ODE TO THE SAN LUIS DRAIN,
H. E. Thomas.
Ground Water GRWAAP, Vol. 24, No. 1, p 79-82, January-February 1986. 1 fig, 1 tab, 5 ref.

Descriptors: *Selenium, *Canals, *Pollutants, *San Luis Drain, San Joaquin River, California, Westlands Water District, Irrigation, Well water, Delta-Mendota Canal.

The San Luis Drain (SLD) is a concrete-lined canal 85 miles long, just west of the San Joaquin River in California's Central Valley, that terminates at the Kesterson National Wildlife Refuge. The SLD has provided information concerning the facts and effects of irrigating only 8,000 acres of seleniferous soils: the dissolving and organic uptake of selenium, its dissemination from ponds, entry into food chains, and accumulation in a wide variety of biota and detritus. If deprived access to SLD, the Westlands Water District (WWD) could direct their toxic wastes down natural slopes by trickling or sumps and drain ditches, but this means toward the Mendota Pool and the Main Canal and Outside Canal which carry water for irrigation and domestic wells; that is more ominous to Merced County that the SLD ever was. The WWD needs detailed testing and mapping of its irrigable lands to discriminate the areas of seleniferous soils from those which are safe for irrigation. In irrigated lands above the Delta-Mendota Canal, sumps and drains are monitored for selenium in toxic concentrations, and irrigation can cease in the areas producing the excessive selenium. Monitors along the Outside and Main Canals (below drainage from known seleniferous areas) might be needed for preservation of good quality, perhaps by dilution with CVP water. (Peters-PTT)
W87-01879

ASSESSING POTENTIAL SOURCES OF ASBESTOS FIBERS IN WATER SUPPLIES OF S.E. QUEBEC,
Queen's Univ., Kingston (Ontario).
D. W. Bacon, O. T. Coomes, A. A. Marsan, and N. Rowlands.
Water Resources Bulletin WARBAQ, Vol. 22, No. 1, p 29-38, February 1986. 4 fig, 2 tab, 53 ref. CP Rail Contract 4715-10.

Descriptors: *Asbestos, *Water pollution sources, *Ecosystems, Quebec, Canada, Rainfall, Drinking water, Railway ballast, Chrysotiles.

A comparative study of the concentration of asbestos fibers in drinking water supplies of southeastern Quebec was undertaken to assess the relative contributions of fibers by asbestos-bearing railway ballast and naturally occurring asbestos deposits. Water samples were taken from areas where one or the other potential sources or neither potential source was present. In addition, rainwater samples were taken to assess the importance of atmospheric contributions. The sampling design accounted for potential variations in fiber counts due to the season, location, and analytical procedures. Fiber concentrations were estimated from counts made on a JEOL 100CX scanning transmission electron microscope and statistically compared among areas. These levels were then compared with levels found in other areas of Canada and the United States. The results indicate that the rail ballast could be contributing statistically (albeit marginally) significant quantities of fibers to water supplies during the summer but not in the spring. Estimated concentrations in water supplies ranged between 1,700,000 fibers/liter and 147,800,000 fibers/liter. Fiber levels in samples taken during the spring were significantly higher and more variable than those taken during the summer. The presence of fibers in rainwater samples at concentrations of 1,900,000 fibers/liter, 18,300,000 fibers/liter, and 23,700,000 fibers/liter suggests that atmospheric transport may play an important role in contributing fibers to regional systems. Fiber levels found in these systems are not unique when compared to levels observed elsewhere in North America. (Author's abstract)
W87-01884

LACTOSE NEGATIVE ESCHERICHIA COLI FROM RANGELAND STREAMS: SOURCE, ANTIBIOTIC RESISTANCE, AND COLICINOGENICITY,
Boise State Univ., ID. Dept. of Biology.
R. C. Rychert, and G. R. Stephenson.
Water Resources Bulletin WARBAQ, Vol. 22, No. 1, p 39-42, February 1986. 4 tab, 21 ref.

Descriptors: *Escherichia coli, *Water pollution sources, *Cattle, *Feces, *Rangeland, *Colicinogenicity, Antibiotic resistance, Water quality, Lactose fermentation.

The source of the lactose-negative Escherichia coli, the frequency of appearance in rangeland stream waters, and the comparative degree of antibiotic resistance and colicinogenicity in the populations of lactose-negative and lactose-positive E. coli were determined. Three rangeland streams were sampled weekly during the May through September grazing seasons of 1980 and 1981. The presence of lactose-negative E. coli colonies on m-FC plates from rangeland streams tended to occur when cattle were grazing; however, lactose-negative E. coli did also appear when cattle were not present. The latter observation may be due to resuspension of stream sediment which can serve as a reservoir of E. coli. Of 111 rangeland stream samples over two grazing seasons, 59 percent of the samples exhibited lactose-negative E. coli. When the lactose-negative E. coli were present, they comprised a mean value of 27 percent of the colonies on m-FC plates. Cattle feces were determined to be a source of rangeland stream lactose-negative E. coli. When the lactose-negative E. coli isolates were examined for antibiotic resistance, 33 percent were resistant to one or more antibiotics, 10 percent were resistant to two antibiotics and none of the isolates was resistant to more than two antibiotics. All 21 lactose-positive E. coli isolates were resistant to three or more antibiotics. When three laboratory strains of E. coli were used as indicators, 83 percent of the lactose-negative E. coli isolates were colicinogenic toward one or more of the indicator strains; whereas 33 percent of the lactose-positive E. coli isolates were colicinogenic toward one or more of the indicator strains. The colicinogenicity of the lactose-negative E. coli toward the rangeland stream lactose-positive E. coli could explain the differences in antibiotic resistance, and possibly impair water quality analyses where lactose fermentations are involved. (Peters-PTT)
W87-01885

EFFECTS OF DEICING SALTS ON WATER CHEMISTRY IN PINHOOK BOG, INDIANA,
Indiana Dunes National Lakeshore, Porter, IN.
D. A. Wilcox.
Water Resources Bulletin WARBAQ, Vol. 22, No. 1, p 57-65, February 1986. 6 fig, 3 tab, 49 ref.

Descriptors: *Roads, *Salts, *Chemical properties, Sodium, Chloride, Pinhook Bog, Indiana, Road-salt runoff, Bog water chemistry, Deicing salts, Salt migration, Peatlands.

A five-year study was conducted to identify the effects of road salt intrusion on the water chemistry of Pinhook Bay following operation of an uncovered salt storage pile adjacent to the bog for ten years. A distinct pattern of elevated salt concentrations was observed in the interstitial waters of the surface peat that corresponded to observed alterations in the bog vegetation. Yearly mean salt concentrations as high as 468 mg/l sodium and 1215 mg/l chloride were recorded in the plant root zone of the peat mat. The salt concentrations decreased significantly each year from 1979 to 1981 throughout the impacted area. Some increases of a lesser magnitude occurred in 1982 and 1983. Analysis of salt movements suggested that vertical transport by water movement was responsible for concentration changes. The major decline in salt levels occurred in the spring following snowmelt and heavy precipitation events. Evapotranspiration during periods of drought resulted in the gradual increases in surface peat salt concentrations. Diverted highway runoff was the major continuing source of sodium chloride contamination and was the likely source of the elevated calcium, magnesium, potassium, bicarbonate, and pH levels also observed in the impacted area. (Author's abstract)
W87-01888

ACCUMULATION OF SELECTED TRACE METALS IN SOILS OF URBAN RUNOFF SWALE DRAINS,
Corvallis Environmental Research Lab., OR.
For primary bibliographic entry see Field 4C.
W87-01890

IDENTIFICATION OF SOLUTE LOADING SOURCES TO A SURFACE STREAM,
Geological Survey, Boston, MA. Water Resources Div.
R. L. Rittmaster, and D. K. Mueller.
Water Resources Bulletin WARBAQ, Vol. 22, No. 1, p 81-89, February 1986. 2 fig, 3 tab, 14 ref.

Descriptors: *Salinity, *Geochemistry, *Gypsum, Dirty Devil River, Utah, Fremont River, Muddy Creek, Hanksville, Total dissolved solids, WATEQF, BALANCE, Solute loading, Loading mechanisms.

Solute-loading sources along the Dirty Devil River, Utah, were identified to determine the occurrence of or potential for solute pickup within the channel. The Dirty Devil River Basin covers 11,000 sq km in south-central Utah. Two principal tributaries, the Fremont River and Muddy Creek, join to form the Dirty Devil near the town of Hanksville. A primary goal was to determine the concentration of gypsum dissolution to total dissolved solids concentration, and its potential increase in the future if salinity control measures are instituted. Synoptic field data were collected during the low flow period in October 1983. Data were analyzed using the geochemistry models WATEQF and BALANCE to postulate mineral reactions leading to solute loading. Three known sources of solute loading, involving two different

geochemical mechanisms, were discernable. Two additional areas of possible gypsum dissolution were located. Total dissolved solids concentration increased from 245 mg/l above Emery to more than 2100 mg/l at Hanksville. Saturation with respect to halite and gypsum, computed by WATEQF, also increased along the flow path. Mass transfer modeling, using BALANCE, showed significant loading from halite sources in two reaches. Both are below washes fed by saline springs and seeps from halite-bearing formations. In general, the WATEQF and BALANCE models were useful in identifying sources of solute loading in the basin. WATEQF provided necessary information on thermodynamic limitation of mineral dissolution in water from a given site. BALANCE was useful in evaluating the loading mechanisms, particularly when the computed mass transfer corresponded to the change in saturation index from WATEQF. Calculations such as those performed by WATEQF and BALANCE provide guidelines and a framework for examining a system in light of known system characteristics and geochemical theory. (Peters-PTT)
W87-01891

EFFECTS OF PLACER GOLD MINING ON PRIMARY PRODUCTION IN SUBARTIC STREAMS OF ALASKA,
Alaska Univ., Anchorage. Arctic Environmental Information and Data Center.
E. E. Van Nieuwenhuyse, and J. D. LaPerriere.
Water Resources Bulletin WARBAQ, Vol. 22, No. 1, p 91-99, February 1986. 5 fig, 4 tab, 41 ref. EPA Project 808340-01.

Descriptors: *Gold mining, *Algae, *Chlorophyll, *Primary production, Alaska, Turbidity, Total residues, Mixed streams, Chlorophyll a, Oxygen.

Turbidity, total residues, settleable solids, vertical light extinction, and primary production were measured in mined and unmined streams located in the interior highlands of Alaska. Undisturbed streams had low turbidities, total residue concentrations averaging 120 mg/l, and undetectable settleable solids. During active mining, turbidity, total residues, and settleable solids levels in a moderately mined stream averaged 170 NTU, 201 mg/l, and < 0.1 ml/l, respectively. In a heavily mined stream, turbidity and total residues were two orders of magnitude higher than in unmined streams and settleable solids nearly always exceeded 0.2 ml/l. Vertical extinction coefficients and turbidity were positively correlated. In undisturbed streams gross primary productivity ranged from 0.20 shortly after spring breakup to a maximum of 1.20 in early fall. Productivity in the moderately mined stream was reduced by 50 percent while photosynthetic efficiency doubled. Primary production was undetectable in a heavily mined stream. Maximum standing crops of periphyton measured as chlorophyll a occurred in fall in an undisturbed stream after 13 weeks of exposure and ranged from 4.5 to 11.8 mg-chl a/sq m. The highest chlorophyll a densities recorded in the moderately mined stream was 3.8 mg/sq m, and no chlorophyll a was detected in the heavily mined stream. (Author's abstract)
W87-01892

EFFECTS OF COAL PILE RUNOFF ON STREAM QUALITY AND MACROINVERTEBRATE COMMUNITIES,
Maryland Univ., Frostburg. Appalachian Environmental Lab.
M. C. Swift.
Water Resources Bulletin WARBAQ, Vol. 21, No. 3, p 449-457, June 1985. 8 tab, 20 ref. DOI Funding A-062-MD.

Descriptors: *Water pollution effects, *Coal mining, *Heavy metals, *Coal, *Macroinvertebrates, *Coal pile runoff, Georges Creek, Allegany County, Maryland, Mercury, Zinc, Arsenic, Iron, Manganese, Aluminum, Hydrogen ion concentration, Leachates.

The chemical composition of coal-pile runoff was described and the effect of this runoff on the water quality of Georges Creek was monitored. The effect of coal-pile runoff on the macroinvertebrate community in Georges Creek was measured. Samples of coal pile runoff, Georges Creek water, and macrobenthos above and below two coal storage areas along Georges Creek, Allegany County, Maryland, were collected in July, August, and September 1982, and February and July 1983. Coal pile runoff was collected under high- and low-flow conditions. Water samples were analyzed for Hg, Zn, As, Fe, Mn, Al, SO4(2-), hydrogen ion concentration, filterable and nonfilterable residue, conductivity and acidity. Leachate from coal piles along Georges Creek contained high concentrations of heavy metals, particularly manganese, aluminum and zinc. Iron and sulfate were very high and the pH ranged from 1.4 to 3.1. Georges Creek water had much lower concentrations of metals, iron and sulfate and a pH of about 7.0. The distribution of macrobenthos in Georges Creek showed the effects of both runoff from coal storage piles and periodic drought. Brillouin's diversity index values were low even in areas which did not dry. Densities of tubificid worms and chironomid larvae were very high above the coal storage areas where organic input were high. At all the rest of the sampling stations, macroinvertebrate densities were very low. Where coal pile runoff enters Georges Creek, it compounds the effects of periodic drought and further stresses the aquatic community. The following kinds of macroinvertebrates were examined: Nematoda, Tubificidae, Asellidae, Gammarus, Cambarus, Baetidae, Gophidae, Gerridae, Veliidae, Sialis, Hydaticus, Tipula, Chironomidae, Heleidae, Tabanus, Simuliidae, Empididae, Muscidae, Basommatophota, Planorbidae, and Sphaeridae. (Peters-PTT)
W87-01917

REVERSIBLE ADSORPTION OF AQUEOUS DIVALENT COPPER ION BY ESTUARINE SEDIMENTS,
Auburn Univ., AL. Dept. of Chemistry.
For primary bibliographic entry see Field 2L.
W87-01919

WATERFALL REAERATION IN THE PASSAIC RIVER,
Cook Coll., New Brunswick, NJ. Dept. of Environmental Science.
C. G. Uchrin, W. K. Ahlert, S. S. Park, and S. R. Schneck.
Water Resources Bulletin WARBAQ, Vol. 21, No. 3, p 475-480, June 1985. 13 fig, 3 tab, 12 ref.

Descriptors: *Waterfalls, *Oxygen deficit ratio, *Dissolved oxygen, *Aeration, *Reaeration, Passaic River, New Jersey, Correlation analysis.

The effect of two mostly natural waterfall systems on the dissolved oxygen concentration in the Passaic River, a rather heavily stressed waterbody in northeast New Jersey, was examined. The two subject waterfalls, Little Falls and Great Falls, are located in urban communities in northeast New Jersey. A parameter defined by past investigators as the 'deficit ratio' was found to be useful for mathematically describing the results. The Great Falls system, which is a 70-foot sheer drop, exhibited deficit ratios which were a function only of temperature for all events, while the Little Falls system, which is a 35-foot cascading system, exhibited deficit ratios which were functions of both temperature and flow. It is hypothesized that the driving forces for the Little Falls system involve both the loss of potential as well as kinetic energy (especially since the power on the flow term in the regressed correlation for the deficit ratio is nearly 2) while the height and nature (sheer drop) of the Great Falls system allows the potential energy loss to dominate. A correlation was successfully regressed to the Great Falls data while a limited correlation was developed for the Little Falls case. The upstream super-saturated waters were deaerated as they passed over the falls. (Peters-PTT)
W87-01921

UPTAKE AND DEPURATION OF ORGANIC CONTAMINANTS BY BLUE MUSSELS (MYTILUS EDULIS) EXPOSED TO ENVIRONMENTALLY CONTAMINATED SEDIMENT,
Rhode Island Univ., Narragansett. Graduate School of Oceanography.
R. J. Pruell, J. L. Lake, W. R. Davis, and J. G. Quinn.
Marine Biology MBIOAJ, Vol. 91, No. 4, p 497-507, June 1986. 7 fig, 2 tab, 45 ref. EPA Assistance agreement CR 808434.

Descriptors: *Organic compounds, *Mussels, *Bioaccumulation, *Path of pollutants, *Mytilus, *Sediments, *Fate of pollutants, Accumulation, Pollutants, Molluska, Contamination, Polychlorinated biphenyls, Biological magnification.

Blue mussels (Mytilus edulis) were exposed to contaminated sediment collected from Narragansett Bay, Rhode Island to allow comparisons of the uptake and depuration of polycyclic aromatic hydrocarbons (PAHs) and polychlorinated biphenyls (PCBs). In addition, concentration factors in the mussels were calculated separately against the dissolved and particulate phase concentrations, and the results from the exposure and control systems were compared. Both PAHs and PCBs were rapidly accumulated by the mussels exposed to the contaminated sediment. After the mussels were transferred to control seawater, individual PAHs were depurated with half-lives ranging from 12 to 30 days. Individual PCBs showed depuration half-lives which ranged from 16 to 46 days. Concentration factors in the mussels calculated against the particulate phase concentrations were very different in the exposure and control systems. Concentration factors calculated using only the dissolved phase concentrations (bioconcentration factors) showed excellent agreement in the two systems, indicating that the dissolved phase may have been the direct source of the contaminants accumulated by the mussels. The bioconcentration factors for PCBs were higher than those of PAHs when compounds with similar n-octanol/water partition coefficients were compared. (Author's abstract)
W87-01942

MYTILUS EDULIS PLANULATUS: AN 'INTEGRATOR' OF CADMIUM POLLUTION,
Victoria Ministry for Conservation, Queenscliff (Australia). Marine Science Labs.
N. Coleman, T. F. Mann, M. Mobley, and N. Hickman.
Marine Biology MBIOAJ, Vol. 92, No. 1, p 1-5, July 1986. 1 fig, 2 tab, 23 ref.

Descriptors: *Mytilus, *Mussels, *Bioindicators, *Bioaccumulation, *Cadmium, *Pollutant identification, Accumulation, Monitoring, Molluska, Heavy metals.

Mussels (Mytilus edulis planulatus) were collected from Port Phillip Bay, Victoria, Australia to test the assumption that they are 'integrators' of cadmium pollution, i.e., that a simple and constant relationship exists between metal levels in the tissues and average metal levels in surrounding water. Groups of mussels were subjected to the same average dose of cadmium, administered according to different dosing regimes over four weeks; other groups received twice the average dose in half the time. During each regime, the mussels were exposed to the different cadmium concentrations for one week at each concentration. Results suggest that, at least for cadmium, the assumption that mussels are 'integrators' of pollution should be treated with caution. They also have implications with regard to the quantitative biological monitoring of pollution. For example, even in a carefully controlled monitoring program, using mussels of standard size and condition, significant differences in cadmium content between mussels need not indicate exposure to different levels of contamination. Rather, these differences could reflect differences in the regime by which the contamination was received. (Author's abstract)
W87-01944

CONTRIBUTION TO THE ECOTOXICOLOGICAL STUDY OF CADMIUM, COPPER AND ZINC IN THE MUSSEL MYTILUS EDULIS: II. EXPERIMENTAL STUDY,

Nantes Univ. (France). Centre de Dosage des Elements Traces.
C. Amiard-Triquet, B. Berthet, C. Metayer, and J. C. Amiard.
Marine Biology MBIOAJ, Vol. 92, No. 1, p 7-13, July 1986. 3 fig, 4 tab, 27 ref. Ministry of Environment (France) Grant 83187.

Descriptors: *Ecological effects, *Heavy metals, *Toxicology, *Cadmium, *Bioaccumulation, *Copper, *Zinc, *Mussels, *Mytilus, Molluska, Bioindicators.

The patterns of accumulation of copper and zinc vs cadmium were compared in the mussel Mytilus edulis. At external levels of zinc as high as 100 micrograms per liter, mussels were able to maintain a normal concentration in all groups of organs for four days. The ability of mussels to limit the bioaccumulation of copper and zinc varied from organ to organ, and decreased with higher levels of contamination and longer periods of exposure. In contrast, a significant increase of cadmium in mussel tissues was generally observed at the lowest experimental concentration and the lowest period of exposure. Even at the highest sub-lethal doses, the levels of copper and zinc in mussel tissues were not much higher than the natural levels, whereas the bioaccumulation of cadmium was less well restricted. The use of mussels as a bioindicator of pollution seems doubtful for essential metals, particularly as regards short-term pollution, since the levels of these trace elements in the organisms are largely independent of their concentration in the ambient seawater. (Author's abstract)
W87-01945

UPTAKE AND CLEARANCE OF DIESEL ALKANES FROM SEDIMENTS BY THE GREAT BARRIER REEF GASTROPOD STROMBUS LUHUANUS,
Griffith Univ., Nathan (Australia). School of Australian Environmental Studies.
H. F. Chapman, and D. W. Connell.
Marine Biology MBIOAJ, Vol. 92, No. 1, p 15-19, July 1986. 4 fig, 17 ref.

Descriptors: *Bioaccumulation, *Diesel alkanes, *Sediments, *Great Barrier Reef, *Gastropods, *Strombus, *Oil spills, Molluska, Fate of pollutants, Accumulation.

Sediments from the reef flat at Heron Island, Great Barrier Reef were treated with known amounts of diesel, and the uptake and clearance characteristics of the diesel n-alkanes by the gastropod Strombus luhuanus were measured in the field and in aquaria. In each case, the uptake curve was unusual in that the concentration, expressed in terms of wet weight, reached maxima within 24 hours and then declined to relatively low levels. The maximum concentrations reached were below those in the sediments. Within the range investigated, the alkanes exhibited a substantial decline in the uptake rate-constant with increasing carbon number, tricosane exhibiting approximately 25% of the uptake rate-constant of dodecane. On the other hand, persistence, measured as half-life, showed an increase with carbon number. Dodecane had a half life of 0.6 day and octadecane one of 2.2 days. (Author's abstract)
W87-01946

SEASONAL DISTRIBUTION OF FACULTATIVELY ENTEROPATHOGENIC VIBRIOS (VIBRIO CHOLERAE, VIBRIO MIMICUS, VIBRIO PARAHAEMOLYTICUS) IN THE FRESHWATER OF THE ELBE RIVER AT HAMBURG,
Hygienisches Inst. (Germany, F.R.).
For primary bibliographic entry see Field 2H.
W87-01957

ANTIBIOTIC RESISTANT BACTERIA IN WINDERMERE AND TWO REMOTE UPLAND TARNS IN THE ENGLISH LAKE DISTRICT,
Freshwater Biological Association, Ambleside (England).
For primary bibliographic entry see Field 2H.
W87-01958

SOURCES OF CARBON AND SULFUR NUTRITION FOR CONSUMERS IN THREE MEROMICTIC LAKES OF NEW YORK STATE,
Indiana Univ. at Bloomington. Dept. of Biology.
For primary bibliographic entry see Field 2H.
W87-01974

BIOGEOCHEMICAL CYCLING OF LIGNOCELLULOSIC CARBON IN MARINE AND FRESHWATER ECOSYSTEMS: RELATIVE CONTRIBUTIONS OF PROCARYOTES AND EUCARYOTES,
Georgia Univ., Athens. Dept. of Microbiology.
For primary bibliographic entry see Field 2H.
W87-01975

DISSOLVED HYDROCARBON METABOLISM: THE CONCENTRATION-DEPENDENT KINETICS OF TOLUENE OXIDATION IN SOME NORTH AMERICAN ESTUARIES,
Alaska Univ., Fairbanks. Inst. of Marine Science.
For primary bibliographic entry see Field 2L.
W87-01976

DOMINANT PROCESSES OF SEDIMENT DISTRIBUTION AND FOCUSING IN A SMALL, EUTROPHIC, MONOMICTIC LAKE,
Freshwater Biological Association, Ambleside (England).
For primary bibliographic entry see Field 2H.
W87-01978

MECHANISMS OF HYDROGEN ION NEUTRALIZATION IN AN EXPERIMENTALLY ACIDIFIED LAKE,
Oak Ridge National Lab., TN. Environmental Sciences Div.
R. B. Cook, C. A. Kelly, D. W. Schindler, and M. A. Turner.
Limnology and Oceanography LIOCAH, Vol. 31, No. 1, p 134-148, January 1986. 3 fig, 6 tab, 65 ref.

Descriptors: *Acidification, *Alkalinity, *Acid rain, *Hydrogen ion concentration, *Lakes, *Sulfate reduction, *Iron reduction, Iron sulfide, Lake 223, Experimental Lakes Area, Ontario, Canada, Bacteria, Hypoliminion, Calcium, Magnesium, Lake sediments, Annual cycle, Cations.

The experimental acidification of Lake 223 (Experimental Lakes Area, northwestern Ontario, Canada) with sulfuric acid in 1976-1983 allowed a detailed examination of the capacity of the lake to neutralize H ion. A whole-lake alkalinity and ion budget of Lake 223 showed that 66-81% of of the added sulfuric acid was neutralized by alkalinity production in the lake. Nearly 85% of in situ alkalinity production was accounted for by net loss of sulfate through bacterial sulfate reduction, coupled with iron reduction and iron sulfide formation, in littoral sediments (60%) and in the hypolimnion (25%). Exchange of H ion for Ca and Mn in the sediments accounted for 19% of the alkalinity generated, whereas other cations were net sinks for alkalinity. Alkalinity input from the watershed of Lake 223 was very small, averaging about 5% of that produced in the lake. The seasonal production of 1,000 microequivalent/liter alkalinity in the anoxic hypolimnion of this softwater lake could be attributed to bacterial sulfate reduction coupled with iron sulfide formation, ammonium production, and iron (II) production. Only the alkalinity produced from bacterial sulfate reduction coupled with iron sulfide formation remained throughout the annual cycle. (Author's abstract)
W87-01979

INORGANIC NITROGEN UPTAKE BY EPILITHIC PERIPHYTON IN A N-DEFICIENT LAKE,
California Univ., Davis. Div. of Environmental Studies.
For primary bibliographic entry see Field 2H.
W87-01980

TRANSPORT OF CADMIUM BY ORGANIC SOLVENTS THROUGH SOIL,
Arizona Univ., Tucson. Dept. of Soils, Water and Engineering.
P. J. Sheets, and W. H. Fuller.
Soil Science Society of America Journal SSSJD4, Vol. 50, No. 1, p 24-28, January-February 1986. 2 fig, 5 tab, 24 ref. EPA Grant No. R807915-01.

Descriptors: *Cadmium, *Solute transport, *Path of pollutants, *Organic solvents, *Soil contamination, Sandy loam, Clay, Soil water, 2-Propanol, Ethylene glycol, River sand, Statistics.

Solutions of 0, 50, and 100% 2-propanol and ethylene glycol in water containing 1 millimolar Cd were perfused through soil columns of river sand, Anthony sandy loam (coarse-loamy, mixed (calcareous), thermic Typic Torrifluvents), or Davidson clay (clayey, kaolinitic, thermic Rhodic Paleudults) at two initial soil moisture contents (air dry and water saturated) to determine if organic solvents have the potential to alter the rate of Cd movement through soils as compared with water alone. Soils adsorbed less Cd from ethylene glycol than from water. Cd breakthrough was rapid and Anthony sandy loam and river sand adsorbed < 6 micromol Cd/gram when leached with Cd-enriched 2-propanol. The 2-propanol increased Cd adsorption compared to water in the Davidson clay. Cd adsorption increased with increasing 2-propanol concentration in the Davidson clay, but decreased with increasing 2-propanol concentration in the other two soils. No consistent trends occurred with increasing ethylene glycol concentration. Davidson clay and river sand adsorbed significantly more Cd at 95% confidence levels from 2-propanol when initially air dry, whereas Anthony sandy loam adsorbed more Cd when initially water saturated. Initial soil moisture content did not significantly affect ethylene glycol transport of Cd at the 95% confidence level. (Author's abstract)
W87-01983

SODICITY LEVELS OF SOILS EQUILIBRATED WITH WASTEWATERS,
Agricultural Research Organization, Bet-Dagan (Israel). Volcani Center.
For primary bibliographic entry see Field 5E.
W87-01984

DECOMPOSITION OF METHYL NITRITE IN SOLUTIONS AND SOILS,
Melbourne Univ., Parkville (Australia). School of Agriculture and Forestry.
A. M. T. Magalhaes, and P. M. Chalk.
Soil Science Society of America Journal SSSJD4, Vol. 50, No. 1, p 72-75, January-February 1986. 2 fig, 5 tab, 25 ref.

Descriptors: *Methyl nitrite, *Path of pollutants, *Fate of pollutants, *Decomposition, *Acid soils, *Alkaline soils, *Chemodenitrification, *Hydrolysis, *Sorption, Sterile Soil, Gamma-radiation, Anchorfield clay soil, Drysdale clay soil, Soil solution.

The role of hydrolysis as a process affecting the concentration of CH3ONO in the soil atmospheres was investigated by measuring the sorption of CH3ONO and the formation of NO2(-) and NO3(-) in two soils (-33kPa soil water potential) and three solutions in the dark at 20 C for 10 hr. Soil pH and the pH of distilled H2O decreased on absorption of CH3ONO. In acidic solutions (distilled H2O and 0.1 Molar (M) H2SO4), > 90% of CH3ONO was recovered as NO3(-), whereas in the alkaline Anchorfield clay soil (pH 8.0) and 0.2 M NaOH, > 80% was recovered as NO2(-). Only 0-7% of CH3ONO remained in the atmosphere. In an acid soil (Drysdale clay, pH 5.8) only 50% of CH3ONO was recovered as (CH3ONO + NO2(-) + NO3(-))-N. Recoveries in gamma-irradiated and nonirradiated soils did not differ significantly. The data indicate that CH3ONO was hydrolyzed rapidly in solutions and in soils and that NO3(-) formed via the self-decomposition of HNO2. The low recovery of N in the acid soil may have been due to the participation of HNO2 in the chemodenitrification reactions. The rapid hydrolysis of CH3ONO is likely to inhibit the emission of CH3ONO formed

in soils, and to cause the sorption of CH3ONO evolved from soils in closed systems. (Author's abstract)
W87-01986

AMMONIA VOLATILIZATION FROM NITROGEN SOURCES APPLIED TO RICE FIELDS: I. METHODOLOGY, AMMONIA FLUXES, AND NITROGEN-15 LOSS,
International Fertilizer Development Center, Muscle Shoals, AL.
I. R. P. Fillery, and S. K. De Datta.
Soil Science Society of America Journal SSSJD4, Vol. 50, No. 1, p 80-86, January-February 1986. 6 fig, 1 tab, 27 ref.

Descriptors: *Ammonia, *Urea, *Urease inhibitors, *Ammonium sulfate, *Nitrogen-15, *Rice fields, *Phenyl phosphorodiamidate, *Volatilization, Soil chemistry, Flooding, Isotope studies, Nitrapyrin, Nitrification inhibitors, Denitrification, Nitrification, Enzymes, Fertilizers.

The extent of NH3 volatilization from (NH4)2SO4, urea, and urea amended with the urease inhibitor phenyl phosphorodiamidate (PPD) was studied concurrently in flooded rice by using nondisturbing micrometeorological techniques. Nitrogen-15 balance techniques were used to estimate the total 15N loss and the relative contribution of NH3 volatilization and nitrification-denitrification to the N loss. N sources were applied to the floodwater 18 days after transplanting the rice seedlings. Ammonia volatilization proceeded rapidly after the application of (NH4)2SO4 and urea, although the pattern of NH3 loss differed among the N sources. Ammonia fluxes accounted for 38 and 36% of the N applied as (NH4)2SO4 or urea, respectively, in an 8-day period. The lower rate of NH3 loss (22% of N applied) occurred within the same period from a field amended with urea + PPD (1% wt/wt), primarily because NH3 fluxes were negligible for at least 3 days after urea was applied. The total 15N loss at the termination of the NH3 loss measurements accounted for 44 and 41% of the (NH4)2SO4 and urea N, respectively. A significantly lower 15N loss (33% N applied) occurred when a nitrification inhibitor (nitrapyrin) was applied with urea. These results suggested that nitrification-denitrification may have contributed slightly to the total N loss from urea. (See also W87-01988) (Author's abstract)
W87-01987

AMMONIA VOLATILIZATION FROM NITROGEN SOURCES APPLIED TO RICE FIELDS: II. FLOODWATER PROPERTIES AND SUBMERGED PHOTOSYNTHETIC BIOMASS,
International Fertilizer Development Center, Muscle Shoals, AL.
I. R. P. Fillery, P. A. Roger, and S. K. De Datta.
Soil Science Society of America Journal SSSJD4, Vol. 50, No. 1, p 86-91, January-February 1986. 6 fig, 2 tab, 30 ref.

Descriptors: *Phenyl phosphorodiamidate, *Urea, *Ammonium sulfate, *Urease inhibitors, *Volatilization, *Ammonia, *Rice fields, *Hydrogen ion concentration, *Cyanophyta, Biomass, Alkalinity, Soil chemistry, Enzymes, Fertilizers, Flooding.

The effects of (NH4)2SO4, urea, and urea amended with the urease inhibitor phenyl phosphorodiamidate (PPD) on the floodwater properties were studied concurrently as part of a field NH3 volatilization study. In the (NH4)2SO4 treatment the maximum ammoniacal-N in the floodwater (about 50 g N/cu m) occurred immediately after application and reached negligible amounts by 6 days after application. With urea, the ammoniacal-N concentrations in the urea treatment reached maxima of 12 g N/cu m 3-5 days after application and negligible levels 7 days after application. Including PPD (1% wt/wt) delayed the buildup of ammoniacal-N to 5-7 days, with a maximal concentration comparable to the urea-only treatment. Marked diurnal fluctuations in pH of the floodwaters were observed, and their alkalinity was far higher than that of irrigation water. Enumeration of algae in the floodwaters showed the biomass to be small and dominated by the non-N2-fixing blue-green algae. This biomass, however, was associated with the marked diurnal fluctuations in pH, which, coupled with the accumulated alkalinity, were the major factors contributing to the rapid NH3 loss following application of (NH4)2SO4 and urea to the floodwater. (See also W87-01987) (Rochester-PTT)
W87-01988

PROPERTIES, CLASSIFICATION, AND INTERPRETATIONS OF MINESOILS AT TWO SITES IN WEST VIRGINIA,
West Virginia Univ., Morgantown. Div. of Plant and Soil Sciences.
For primary bibliographic entry see Field 2G.
W87-01994

DERIVATION OF LAND QUALITIES TO ASSESS ENVIRONMENTAL PROBLEMS FROM SOIL SURVEYS,
Stichting voor Bodemkartering, Wageningen (Netherlands). Dept. of Soil Chemistry.
For primary bibliographic entry see Field 7C.
W87-01995

PORE GAS COMPOSITION IN WASTE ROCK DUMPS UNDERGOING PYRITIC OXIDATION,
Australian Atomic Energy Commission Research Establishment, Sutherland.
J. R. Harries, and A. I. M. Ritchie.
Soil Science SOSCAK, Vol. 140, No.2, p 143-152, August 1985. 10 fig, 17 ref.

Descriptors: *Mine wastes, *Oxygen, *Carbon dioxide, *Soil atmosphere, *Acid pollution, *Trace metal pollution, *Australia, *Bacteria, Metabolism, Gas transport, Thermal effects, Atmospheric pressure, Bacterial physiology, East Branch Finnis River, Pyritic material.

Oxygen and carbon dioxide concentrations in the pore space of two waste rock dumps were measured; the dumps are significant sources of acid and trace metal pollutants to the East Branch Finnis River, Northern Territory of Australia. These pollutants are released as a result of the oxidation of pyritic material within the dumps, which are at the abandoned Rum Jungle mine. Comparison of oxygen concentration distributions with heat source distributions indicates that oxygen supply is the oxidation-rate-limiting mechanism in most regions of the dumps. Gas transport into the dumps is by diffusion and advection due to both thermal effects and atmospheric pressure changes. The extent to which one transport mechanism dominates reflects the proximity of the edge of the dump and differences in the properties of the materials in different regions. In some areas, at least two transport mechanisms determine the pore gas composition. Carbon dioxide levels, which generally are 1-3 orders of magnitude higher than atmospheric levels, indicate that the bacteria that catalyze the pyritic oxidation have a plentiful supply of carbon dioxide, which is essential for their metabolism. (Author's abstract)
W87-02010

COMPUTER SIMULATIONS OF THE TRANSPORT OF PESTICIDES WITH NONUNIFORM WATER FLOW IN GREENHOUSE SOIL,
Institute for Pesticide Research, Wageningin (Netherlands).
M. Leistra.
Soil Science SOSCAK, Vol. 140, No. 3, p 161-169, September 1985. 8 fig, 14 ref.

Descriptors: *Methomyl, *Pesticides, *Path of pollutants, *Diazinon, *Transport, *Mathematical models, Geometry, Nonuniform flow, Leaching, Irrigation, Insecticides, Greenhouse soils.

Three computation models were to simulate the transport of the insecticides methomyl and diazinon in the root zone of a greenhouse soil. Two models simulated nonuniform flow of water in a slab geometry and in a cylindrical geometry. Soil regions with vertical and horizontal flow were distinguished. In those models, nonuniform flow produced more leaching of methomyl from the root zone than did nonuniform flow. The differences in leaching computed with the slab and cylindrical geometries were small. Narrowing the region with downward flow increased the simulated leaching to a certain level. Reduction in scale of the irregularities increased the interchange of pesticide between the regions with vertical and horizontal flow, resulting in less leaching. When the properties of diazinon were introduced into the computations with nonuniform flow, there was hardly any leaching according to the model, but when the compound was simulated to be applied in the same place as the irrigation, the extent of leaching strongly increased. (Author's abstract)
W87-02011

MOVEMENT OF SURFACE AND DEEP-PLACED PHOSPHORUS IN A SANDY LOAM SOIL IN RELATION TO INITIAL SOIL WETNESS, AMOUNT OF WATER APPLIED, AND EVAPORATION POTENTIALS,
Indian Agricultural Research Inst., New Delhi. Div. of Agricultural Physics.
For primary bibliographic entry see Field 2G.
W87-02015

EFFECT OF SIMULATED ACID RAIN ON NITRATE AND AMMONIUM PRODUCTION IN SOILS FROM THREE ECOSYSTEMS OF CAMELS HUMP MOUNTAIN, VERMONT,
Vermont Univ., Burlington. Dept. of Plant and Soil Science.
For primary bibliographic entry see Field 5C.
W87-02018

HIGH LEVELS OF MUTAGENIC ACTIVITY IN CHLORINATED DRINKING WATER IN FINLAND,
Kuopio Univ. (Finland). Dept. of Chemistry.
T. Vartiainen, and A. Liimatainen.
Mutation Research MUREAV, Vol. 169, No. 1/2, p 29-34, January-February 1986. 4 fig, 2 tab, 19 ref.

Descriptors: *Toxicity, *Drinking water, *Chlorination, *Finland, Carcinogens, Adsorption, Water treatment, Gas chromatography, Mass spectrometry, Pollution, Mutagens, Trichloromethane, Ion exchange, Water quality.

Large-scale studies on drinking water mutagenicity were begun when chlorinated drinking water contained trihalomethanes, among them a suspected carcinogen, trichloromethane. Drinking water samples were taken from a laboratory tap at the University of Kuopio, with the water source being the waterworks from Lake Kallavesi, which carries a relatively high content of humic compounds of natural origin, and effluents from a pulp mill. The raw water is disinfected with chlorine and treated with lime, aluminium sulfate and carbon dioxide. Fluoride is added after chlorination. Isolation of organic compounds was carried out by a continously extracting liquid-liquid apparatus or by adsorption on XAD 8 resin. The organic phases were dried and concentrated in a Kuderna-Danish evaporator, and some of the samples were analyzed by gas chromatography-mass spectrometry. The organic extract turned out to be highly mutagenic in the Ames test. The direct mutagenic activities of the acid/neutral fractions of 48 drinking water samples were on an average 1700 net revertants/l in strain TA100. The highest activities were more than 6,000 net revertants/l and one drinking water sample exceeded 10,000 net revertants/l. (Khumbatta-PTT)
W87-02041

FLOW AND CONTAINMENT OF INJECTED WASTES,
Du Pont de Nemours (E.I.) and Co., Wilmington, DE. Central Research and Development Dept.
For primary bibliographic entry see Field 5E.
W87-02052

SUBSURFACE DISPOSAL OF LIQUID LOW-LEVEL RADIOACTIVE WASTES AT OAK RIDGE, TENNESSEE,
Oak Ridge National Lab., TN.
For primary bibliographic entry see Field 5E.
W87-02053

CHEMICAL FATE OF INJECTED WASTES,
Du Pont de Nemours (E.I.) and Co., Wilmington, DE. Engineering Dept.
N. C. Scrivner, K. E. Bennett, R. A. Pease, A. Kopatsis, and S. J. Sanders.
Ground Water Monitoring Review, Vol. 6, No. 3, p 53-58, Summer 1986. 4 fig, 3 tab, 14 ref.

Descriptors: *Path of pollutants, *Fate of pollutants, *Injection wells, *Underground waste disposal, *Computer simulation, *Electrolyte solutions, Hydrogen ion concentration, Cyanide, Hydrolysis, Sand dissolution, Iron chlorides, Hydrochloric acid, Dolomite, Mathematical models, Ion exchange, Clay, Clay dissolution, Fluid density, Neutralization, Precipitation.

Neutralization, hydrolysis, and precipitation of wastes injected into wells were modeled using published data on reaction rates and equilibrium constants for the dominant reactions, which were incorporated into a sophisticated computer simulation that calculates solid-liquid equilibria of aqueous electrolyte solutions. The mode predicted the fate of two waste streams: (1) high-pH, cyanide-containing waste injected into sandstone is made less hazardous by hydrolysis and sand dissolution; and (2) FeCl3-FeCl2-HCl-H20 waste is made non-hazardous by reaction with dolomite. Future development of the model will incorporate other phenomena, including co-precipitation of trace heavy metal ions, ion exchange of cations into clay, clay dissolution, and fluid density calculations. (Rochester-PTT)
W87-02054

ACIDITY OF SCOTTISH RAINFALL INFLUENCED BY CLIMATIC CHANGE,
University of East Anglia, Norwich (England). Climatic Research Unit.
T. D. Davies, P. M. Kelly, P. Brimblecombe, G. Farmer, and R. J. Barthelmie.
Nature NATUAS, Vol. 322, No. 6077, p 359-361, July 24, 1986. 4 fig, 22 ref.

Descriptors: *Acidity, *Scotland, *Rainfall, *Climatology, *Acid rain, Chemical properties, Weather, Air pollution, Emission control.

Although there are clear links between acidic deposition and synoptic meteorology, the effects of climatic change have been largely neglected. Long-term variations in the atmospheric circulation and associated changes in trajectory characteristics on timescales of years and longer can affect deposition levels within the United Kingdom, masking the effects of changing emissions. The results provide empirical support for the suggestion that climatic change may need to be considered in the assessment of emission control strategies. (Author's abstract)
W87-02078

FATE OF THIOBENCARB AND MOLINATE IN RICE FIELDS,
California Dept. of Food and Agriculture, Sacramento.
L. J. Ross, and R. J. Sava.
Journal of Environmental Quality JEVQAA, Vol. 15, No. 3, p 220-225, July-September 1986. 1 fig, 6 tab, 21 ref. Calif. State Water Control Board Interagency Agreement No. 2-127-428-0.

Descriptors: *Fate of pollutants, *Thiobencarb, *Molinate, *Herbicides, *Rice, Dissipation, Water management, Agricultural chemicals, Adsorption, Field tests, Volatility, Solubility.

The fate of thiobencarb and molinate in air, water, soil and vegetation samples from a rice field was documented for 45 days following application to examine the effectiveness of water-holding periods at reduced herbicide concentration under grower-controlled field conditions and to calculate mass balance budgets. Field study results reflected different physico-chemical properties than those established in the laboratory. Thiobencarb is less volatile and water soluble and more strongly adsorbed to soil than molinate, thus accounting for lower air and water concentrations and higher field soil concentrations of thiobencarb. It also reaches higher concentrations in vegetation. The amount of herbicide in vegetation comprises less than one percent of both mass balance budgets. A holding period appears to be more effective for molinate than thiobencarb, and mass balance information obtained in this study may contribute to understanding herbicide dynamics in the field. (Michael-PTT)
W87-02086

PH BUFFERING IN FOREST SOIL ORGANIC HORIZONS: RELEVANCE TO ACID PRECIPITATION,
New York State Agricultural Experiment Station, Geneva.
B. R. James, and S. J. Riha.
Journal of Environmental Quality JEVQAA, Vol. 15, No. 3, p 229-234, July-September 1986. 4 fig, 3 tab, 33 ref.

Descriptors: *Hydrogen ion concentration, *Buffering, *Forest soils, *Acid rain, *Decomposing organic matter, Hydrogen ions, Calcium, Cations, Acidic soils, Acidity, Aluminum, Solubility, Protonation, New York.

A batch technique designed to simulate acid rain reactions on forest floors was performed using samples of New York State forest soils equilibriated with HNO3 treated soil. Each organic horizon retained a constant percentage of added hydrogen ion regardless of the quantity of added acidity. Buffer capacities of the samples were higher than those measured in underlying mineral horizons. Calcium was the dominant cation in unacidified equilibrium solutions and its concentration changed in response to soil acidification. Aluminum was a minimal contributor to cationic change. Anion protonation of weak organic acids in solution and solid phases accounted for hydrogen ion removal without increasing cation concentration. Because of this removal by forest floor organics and calcium dominance in equilibrium solutions, the impact of acid rain on aluminum solubility in forest soils is due more to Ca(NO3)2 and CaSO4 in leaching water than the direct effects of HNO3 and H2SO4. (Michael-PTT)
W87-02088

DETERMINATION OF ALKYLLEAD SALTS IN RUNOFF, SOILS, AND STREET DUSTS CONTAINING HIGH LEVELS OF LEAD,
Macdonald Coll., Ste. Anne de Bellevue (Quebec). Dept. of Food Science and Agricultural Chemistry.
J. S. Blais, and W. D. Marshall.
Journal of Environmental Quality JEVQAA, Vol. 15, No. 3, p 255-260, July-September 1986. 3 fig, 5 tab, 19 ref.

Descriptors: *Alkyllead salts, *Runoff, *Soil chemistry, Street dusts, *Fate of pollutants, *Lead, Gas chromatography, Atomic absorption spectroscopy, Stream runoff, Inorganic lead, Leaded gasoline.

A modified procedure was developed for selective, complexomatic extraction of alkyllead salts from soils, urban street dusts and rainwater runoff. Sample extracts were butylated and analyzed by gas chromatography-atomic absorption spectroscopy. Re-extraction with methyl-isobutyl ketone-dithizone permitted recovery of Pb(2+). Ethyllead salts, but not methyllead salts, were detected in all samples. Concentrations of these samples were significantly correlated with levels of extractable Pb(2+), but not with total lead. The major health hazard associated with street dusts, contaminated soils and storm runoff results from inorganic lead. The alkylleads make only a minor, toxicologically insignificant contribution to the total lead burden of these samples. (Michael-PTT)
W87-02090

NITRATE LEACHING THROUGH SANDY SOIL AS AFFECTED BY SPRINKLER IRRIGATION MANAGEMENT,
Nebraska Univ., North Platte. Dept. of Agronomy.
For primary bibliographic entry see Field 3F.
W87-02092

HEAVY METALS IN COTTONTAIL RABBITS ON MINED LANDS TREATED WITH SEWAGE SLUDGE,
Pennsylvania State Univ. DuBois Campus.
R. L. Dressler, G. L. Storm, W. M. Tzilkowski, and W. E. Sopper.
Journal of Environmental Quality JEVQAA, Vol. 15, No. 3, p 278-281, July-September 1986. 5 tab, 18 ref.

Descriptors: *Heavy metals, *Rabbits, *Path of pollutants, *Fate of pollutants, *Sludge utilization, *Strip mines, *Land reclamation, Pennsylvania, Cadmium, Curium, Zinc, Accumulation, Animal tissues, Wildlife.

Levels of heavy metals in soils, vegetation and tissues of cottontail rabbits at a Pennsylvania strip mine site treated with sewage sludge were compared with those from a non-treated site to determine trace metal increases due to treatment effect. Cadmium, curium and zinc concentrations were higher in vegetation at the treated site. Zinc was higher in rabbit femurs from the treated site, but levels of most metals in rabbit tissue from the treated site were comparable to that from a non-treated site and a non-mined area. Baseline values for cadmium uptake were established by feeding captive rabbits a cadmium-supplemented diet. Liver and muscle tissue from rabbits collected from treated sites contained higher cadmium levels than laboratory controls, but did not accumulate hazardous levels of metals from the treated site. It is concluded that occasional consumption of cottontail rabbit from the treated site should pose no threat to human health. (Michael-PTT)
W87-02093

CHEMICAL QUALITY OF SUSPENDED SEDIMENT FROM WATERSHEDS SUBJECTED TO SURFACE COAL MINING,
Ohio Agricultural Research and Development Center, Wooster.
W. A. Dick, J. V. Bonta, and F. Haghiri.
Journal of Environmental Quality JEVQAA, Vol. 15, No. 3, p 289-293, July-September 1986. 2 fig, 3 tab, 16 ref.

Descriptors: *Suspended sediments, *Small watersheds, *Ohio, *Surface runoff, *Mine drainage, *Strip mine wastes, Land reclamation, Overburden, Limestone, Sediment transport, Sediment carrying capacity, Chemical composition, Calcium, Magnesium, Strontium, Sandstone, Shale, Sediment concentration, Sedimentary basins.

Suspended sediment samples were collected from three small watersheds in Ohio before, during and after surface coal mining and reclamation to determine chemical quality. Differences in chemical concentrations were observed among the watersheds and were attributed to composition of the overburden material. Sediments from a limestone dominated watershed had higher calcium, magnesium and strontium concentrations and higher pH than did sediment obtained from a sandstone-shale dominated watershed. Sediment chemistry changes due to watershed disturbance are highly variable, but the changes that occurred during mining and reclamation were reversed as a result of reclamation. Parameter concentrations at two watersheds returned to near normal pre-mine values after reclamation. There was no statistically significant change in chemical quality of sediment materials due to residence in sediment ponds, but most parameter concentrations were elevated in pond effluent compared to the influent. The geologic composition of a mined watershed appears to have the greatest influence on the chemistry of eroded and transported sediment. (Michael-PTT)
W87-02094

FATE OF AMMONIUM IN A GULF COAST ESTUARINE SEDIMENT,
Louisiana State Univ., Baton Rouge.
C. J. Smith, and R. D. De Laune.
Journal of Environmental Quality JEVQAA, Vol. 15, No. 3, p 293-297, July-September 1986. 4 fig, 3 tab, 22 ref.

Descriptors: *Ammonium, *Fate of pollutants, *Estuaries, *Gulf Coast, *Sediments, *Radio tracers, Nitrification, Denitrification, Aerobic conditions, Anaerobic conditions, Water depth, Volatility, Bottom sediments.

The fate of NH4(+) and net NH4(+)-N loss from Gulf Coast saline estuarine bottom sediment columns amended with 15N-labeled (NH4)2SO4 was determined in a laboratory experiment. Simlutaneous determinations of inorganic NH4(+), NO2(-) + NO3(-) and organic nitrogen were made at selected depth intervals within the sediment columns and total NH4(+)-N loss was estimated from 15N balance. Ammonia volatization was also studied. Concentrations of NH4(+)-N generally increased with depth with the largest gradients near the surface. Ammonification was significant in underlying anaerobic sediment. Surface sediment became depleted of 15NH4(+)-N with time of incubation due to nitrification. Nitrogen-15 losses occurred in the surface layer primarily from nitrification-denitrification of the NH4(+). Ammonium incorporation into the organic nitrogen fraction was greater in aerobic surface sediment than in underlying anaerobic sediment. (Michael-PTT)
W87-02095

INFLUENCE OF SULFATE, NITRATE, AND CHLORIDE IN SIMULATED ACIDIC RAIN ON RADISH PLANTS,
California Dept. of Food and Agriculture, Sacramento.
J. S. Jacobson, J. J. Troiano, L. I. Heller, and J. Osmeloski.
Journal of Environmental Quality JEVQAA, Vol. 15, No. 3 p 301-304, July-September 1986. 3 tab, 24 ref.

Descriptors: *Water pollution effects, *Acid rain, *Sulfuric acid, *Nitric acid, *Hydrochloric acid, *Simulated rainfall, *Hydrogen ion concentration, Anions, Chemistry of precipitation, Radish plants, Agriculture, Acidity.

Experiments were conducted to determine whether the major anionic components of rain affect plant growth or modify plant response to rain acidity. Radish plants were exposed to sulfuric, nitric and hydrochloric acid at various pH levels. Reductions in hypocotyl growth, but not shoot growth, were experienced at the lower pH range. Both linear and quadratic components of the dose response function for acidity effects on hypocotyl dry mass were significant. Anions did not significantly affect hypocotyl dry mass nor did anion interaction cause significant acidity. These experiments suggest that differences in concentrations of anionic components of rain may not be important for agricultural crops. The validity of these conclusions should be tested for other species and under different environmental, edaphic and treatment conditions. (Michael-PTT)
W87-02097

MODELING RADIOTRACERS IN SEDIMENTS: COMPARISON WITH OBSERVATIONS IN LAKE HURON AND MICHIGAN,
Wisconsin Univ.-Milwaukee. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2J.
W87-02125

EFFECT OF TEMPERATURE ON THE WATER SOLUBILITY OF INSECTICIDES,
Department of Agriculture, London (Ontario). Research Centre.
B. T. Bowman, and W. W. Sans.
Journal of Environmental Science and Health (B) JPFCD2, Vol. 20, No. 6, p 625-631, 1985. 2 tab, 4 ref.

Descriptors: *Temperature effects, *Insecticides, *Solubility, *Physiochemical properties, Molecular structure, Predictions, Mathematical studies.

Water solubility of 30 insecticides was determined at 10, 20 and 30 C. Except for diazinon and chlorfenvinphos, correlation between solubility and temperature was positive for all insecticides. The magnitude of this effect appeared larger for solids than liquids, and within the solids group, tended to increase with increasing molecular weight of the compound. Data demonstrate that the temperature-solubility relationship is dependent on the Apparent Differential Heat of Solution. This value can be useful in predicting solubility within the studied range and can provide approximate solubility figures for temperatures five to ten degrees on either side of the range. (Michael-PTT)
W87-02132

ORGANOCHLORINE RESIDUES IN FINFISH FROM MARYLAND WATERS, 1976-1980,
Maryland Dept. of Health and Mental Hygiene, Baltimore.
M. Eisenberg, and J. J. Topping.
Journal of Environmental Science and Health (B) JPFCD2, Vol. 20, No. 6, p 729-742, 1985. 4 tab, 13 ref.

Descriptors: *Organic pesticides, *Herbicides, *Path of pollutants, *Fish, *Maryland, *Chesapeake Bay, Tissue analysis, Reproductive organs, Polychlorinated biphenyls, Organic compounds, Heptachlor, DDD, DDE, DDT, Dieldrin, Endrin, Heptachlorepoxide, Lindane, Mirex, Methoxychlor, Aldrin, Toxaphene, Hexachlorobenzene, Kepone, Dachtal, Perch, Bass, Shad, Fate of pollution.

Organochlorine insecticide and herbicide levels were monitored in fish samples from Maryland's Chesapeake Bay and its tributaries. Eighteen chlorinated hydrocarbons were studied, including polychlorinated biphenyls (PCBs), chlordane, heptachlor, DDD, DDE, DDT, dieldrin, endrin, heptachlorepoxide, lindane, mirex, methoxychlor, aldrin, toxaphene, hexachlorobenzene, kepone and dachtal. Organochlorine residue levels were determined in reproductive tissue of several samples. Striped bass and white and yellow perch showed higher concentrations of organochlorine residues, particularly PCBs, chlordane, DDD and dieldrin. Higher levels of six organochlorine residues in gonad tissue of shad were found contrary to findings of similar studies which indicated no such enhancement. All mean and individual values of organochlorine concentrations were within U.S. Food and Drug Administration action levels. (Michael-PTT)
W87-02133

TRACE METAL ADSORPTION/COPRECIPITATION ON HYDROUS FERRIC OXIDE UNDER REALISTIC CONDITIONS: THE ROLE OF HUMIC SUBSTANCES,
Edinburgh Univ. (Scotland). Dept. of Geology.
D. P. H. Laxen.
Water Research WATRAG, Vol. 19, No. 10, p 1229-1236, 1985. 6 fig, 3 tab, 37 ref.

Descriptors: *Trace metals, *Adsorption, *Path of pollutants, *Humic substances, Cadmium, Curium, Nickel, Lead, Ferric oxide, Hydrogen ion concentration, Alkalinity, Speciation, Metals, Ions, Calcium, Magnesium.

Adsorption of Cd, Cu, Ni and possibly Pb onto hydrous ferric oxide is significantly modified in the presence of humic substances. Experiments using synthetic freshwater showed that adsorption/coprecipitation of Cd, Ni and less certainly Pb is enhanced by humics, but any effect for Cu is masked by its strong competitive complexation with soluble humics. pH dependency is modified in a manner consistent with ligand like metal adsorption. One of the four models used to account for enhanced adsorption involves complexation of metals with adsorbed humics which is stronger than that with soluble humics. Experiments using natural water demonstrated the generality of observations made with synthetic water. Cu adsorption was found to be independent of alkalinity, while Cd adsorption, which was independent of humic concentration, was dependent on alkalinity. Neither Ca/Mg nor HCO3/CO3 ions influenced Cu adsorption or complexation reactions, but competition from Ca/Mg ions caused a decrease in Cd adsorption as alkalinity increased. These finding have important implications in the development of speciation models. (Author's abstract)
W87-02150

CONTAMINATED SEDIMENTS OF LAKES AND OCEANS ACT AS SOURCES OF CHLORINATED HYDROCARBONS FOR RELEASE TO WATER AND ATMOSPHERE,
Lund Univ. (Sweden). Limnological Inst.
P. Larsson.
Nature NATUAS, Vol. 317, No. 6035, p 347-349, September 26, 1985. 2 fig, 14 ref.

Descriptors: *Lakes, *Oceans, *Chlorinated hydrocarbons, *Water pollution sources, *Path of pollutants, *Air pollution, *Sediments, *Contamination, *Hydrocarbons, Atmosphere, Hydrosphere, Pollution, Aromatic hydrocarbons.

Atmospheric transport is said to be a major route for entry of chlorinated, aromatic hydrocarbons into aquatic ecosystems. The compounds once they are in the water are readily taken up by the biota and distributed in the food webs. Major fractions of the compound are deposited in the sediment, as some of the most persistent contaminants are inactivated in this way because of their lipophilic properties. The results from recent laboratory studies have raised the possibility that aquatic sediments may not be the final sink for the substances but may rather act as a source through redistribution of the compounds to water and the atmosphere. Polychlorinated biphenyls (PCB's) are regarded as a tracer for those contaminants in the ecosystem. Studies of the transport of PCBs from sediment to water and air in two artificial ponds in the field showed that the transport from the sediment followed a seasonal cycle; the higher concentrations of PCBs in water and air were recorded in the summer and lower in the winter. PCB concentrations in the air over the ponds were positively correlated with PCB levels in the water. The contaminated sediments may act as a source of chlorinated hydrocarbons released into the environment. (Author's abstract)
W87-02174

REGIONAL ACIDIC CLOUD/FOG WATER EVENT IN THE EASTERN UNITED STATES,
Institute of Ecosystem Studies, Millbrook, NY.
For primary bibliographic entry see Field 2B.
W87-02177

SORPTION AND DESORPTION OF ZN ON CA-KAOLINITE,
Instituto Venezolano de Investigaciones Cientificas, Caracas. Centro de Ecologia y Ciencias Ambientales.
J. Garcia-Miragaya, and M. Davalos.
Water, Air, and Soil Pollution WAPLAC, Vol. 27, No. 3/4, p 217-224, 1986. 2 fig, 2 tab, 21 ref.

Descriptors: *Sorption, *Desorption, *Path of pollutants, *Zinc, *Ca-kaolinite, Toxins, Micronutrients, Atomic absorption spectrophotometry, Langmuir analysis.

Zinc is an important heavy metal in soil-water systems because it is a micronutrient in plants and animals as well as humans. It can also be present in toxic amounts. Experiments on Zn(2+) sorption-desorption by Ca-kaolinite using a wide range of Zn(2+) concentrations and two acid pH values allowed us to reach the following conclusions: (1) For Zn(2+) surface coverages below the kaolinite C.E.C., Zn(2+) was sorbed mainly via ion exchange; (2) At Zn(2+) sorption values above the C.E.C., Zn(2+) was sorbed with higher affinity by a mechanism stronger than ion exchange, involving a strong association of Zn ions with silicate solid phases; and (3) Use of C.E.C. values and/or Langmuir's calculated maxima would underesti-

mate Zn(2+) sorption capacity by kaolinite, even at acid pH values. (Main-PTT)
W87-02185

REACTOR TECHNIQUE FOR PREDICTION OF DISSOLVED OXYGEN PROFILES IN STREAMS,
Virginia Polytechnic Inst. and State Univ., Blacksburg.
For primary bibliographic entry see Field 5A.
W87-02188

MODELING ENTERIC BACTERIAL DIE-OFF: A REVIEW,
Oregon State Univ., Corvallis. Dept. of Agricultural Engineering.
by, S. R. Crane, and J. A. Moore.
Water, Air, and Soil Pollution WAPLAC, Vol. 27, No. 3/4, p 411-439, 1986. 3 fig, 4 tab, 82 ref.

Descriptors: *Enteric bacteria, *Fate of pollutants, *Mathematical models, *Bacterial pollution, *Bacteria die-off, Water storage systems, Sludge treatment.

To protect surface and groundwater resources from enteric bacterial pollution, management practices must be devised based on a sound knowledge of these organisms in the environment. Areas covered in this article include the effects of physical and chemical characteristics of the environment, mathematical modeling approaches of bacterial die-off, and a summary of past investigations of bacterial die-off in storage systems, soil, and fresh/sea water environments. The greatest need for future research efforts is to determine the relationships of environmental and physical parameters to bacterial survival. (Author's abstract)
W87-02195

ATMOSPHERIC DEPOSITION TO REMOTE RECEPTORS: II. TEMPORAL AND SPATIAL VARIATION OF INORGANIC ION SPECIES IN PRECIPITATION OVER THE ILWAS-NET-WORK,
Rensselaer Polytechnic Inst., Troy, NY. Dept. of Chemical and Environmental Engineering.
E. R. Altwicker, A. H. Johannes, and N. L. Clesceri.
Water, Air, and Soil Pollution WAPLAC, Vol. 28, No. 1/2, p 55-70, 1986. 9 fig, 8 tab, 10 ref.

Descriptors: *Acid rain, *Atmospheric deposition, *Precipitation, *ILWAS-net York, Wetfall, Watershed, Specific conductance, Acidification, Lake watershed.

Measurement of SO4(--), NO3(-), Cl(-), NH4(+), Ca(++), Mg(++), Na(+), K(+), pH, and specific conductance, were made on a precipitation event basis in a 4 to 7 site network which operated for 45 months in the Adirondack Park of New York State. Three of the seven sites operated for the entire study period to provide a temporal record which is spatially resolved over an intersite distance of 30 km or less. Species concentrations received by the three watersheds were similar. The highest H(+) and SO4(--) ion concentrations were observed during the summers and NO3(-) was found to be relatively invariant. Segregation by precipitation type indicated that the SO4/NO3 in winter rain was much larger than in snow. More than 50% of the total loading of major ions to these watersheds occurred during a 4 month period, May-September. Loading to one of the watersheds averaged approximately 20% less than to the two other watersheds. (See also W87-0219, W87-02199) (Author's abstract)
W87-02198

DDT RESIDUES IN THE RIVER JAMUNA IN DELHI, INDIA,
Delhi Univ. (India). Dept. of Zoology.
H. C. Agarwal, P. K. Mittal, K. B. Menon, and M. K. K. Pillai.
Water, Air, and Soil Pollution WAPLAC, Vol. 28, No. 1/2, p 89-104, 1986. 5 ref.

Descriptors: *DDT, *Delhi, India, Water contamination, Sediment contamination, Biota contamination, Industrial discharge, Extraction, Gas chromatography, Sediments, Crustaceans, Molluscs.

DDT residues in water, bottom sediments and certain non-target organisms from four different sites of the river Jamuna in Delhi were monitored from 1976 to 1978. All samples contained DDT residues. The concentrations of total DDT residues ranged from 0.04 to 3.42 microgram per L in water, 0.007 to 5.63 mg per kg in bottom sediments, 0.05 to 15.42 mg per kg in various invertebrates and 0.54 to 56.31 mg per kg in different fish. The total DDT concentration was comparatively higher at a downstream site where there is a mixing of river water with the discharge from a drain which carries effluents of a DDT factory along with that of other industries. No significant correlation was found between total DDT concentration obtained in water with those found in sediments collected from the same sites. Among the DDT residues, p,p'-DDT and p,p'-DDE were predominant, being detected in most of the samples while p,p'-DDD and o,p'-DDT were detected in a lesser number of samples. (Author's abstract)
W87-02200

DENSITY OF INFLOWS TO ONONDAGA LAKE, U.S.A., 1980 AND 1981,
Upstate Freshwater Inst., Inc., Syracuse, NY.
S. W. Effler, and E. M. Owens.
Water, Air, and Soil Pollution WAPLAC, Vol. 28, No. 1/2, p 105-115, 1986. 4 fig, 1 tab, 21 ref.

Descriptors: *Onondaga Lake, *Density stratification, *Water pollution effects, *Inflow, Ionic waste, Density stratification, Chlorinity, Mercuric loading, Nutrient cycling.

The temporal distributions of the densities of inflows to Onondaga Lake were calculated for spring to fall period of 1980 and 1981, and compared to the attendant density stratification in the ion enriched lake. The industrial utilization of the lake resulted in substantial density differences between the inflows and the lake. Inflows carrying substantial fractions of industrial ionic waste were more dense than the lake, and at times plunged to stratified layers. Water withdrawn from the lower layers of the lake for industrial cooling was displaced to the upper layers as a result of heating. Dilute fluvial inflows were substantially less dense than the lake. The density differences between the inflows and the lake were largely responsible for the unique features of density stratification documented for the lake in 1980, and are probably of further importance in nutrient loading to, and cycling in, Onondaga Lake. (Author's abstract)
W87-02201

TRACING FAECAL POLLUTION BY COPROSTANOL AND INTESTINAL BACTERIA IN AN ICE-COVERED FINNISH LAKE LOADED WITH BOTH INDUSTRIAL AND DOMESTIC SEWAGE,
Bayreuth Univ. (Germany, F.R.). Lehrstuhl fuer Hydrologie.
S. Dureth, R. Herrmann, and K. Pecher.
Water, Air, and Soil Pollution WAPLAC, Vol. 28, No. 1/2, p 131-149, 1986. 10 fig, 4 tab, 33 ref.

Descriptors: *Fecal pollution, *Coprostanol, *Intestinal bacteria, Sewage, Settling, Suspended sediments, Extraction, Sorption, Streptococci, Coliforms, Bioindicators.

The relationship between coprostanol (5beta-cholestan-3beta-ol), fecal indicator bacteria and various physico-chemical tracer and bacterial stress factors in an ice-covered Finnish lake were investigated. Field observations show that coprostanol lies below the theoretical mixing line, indicating a net removal, primarily by settling together with suspended sediments. Fecal indicator bacteria, however, are differently transported and are removed by various environmental factors e.g. industrial wastes. Thus, only fecal streptococci show a regional covariance to coprostanol. Principal component analyses reveal a strong correlation between coprostanol and fecal streptococci in water but not with coliforms and sulfite reducing sporing anaerobs. However, in sediments coliforms also are correlated significantly with coprostanol and faecal streptococci. Therefore, it might be necessary to estimate the quality of those waters polluted by both industrial and fecal wastes by means of coprostanol. (Author's abstract)
W87-02203

AUTOCHTHONOUS BACTERIA IN THE CHALK AND THEIR INFLUENCE ON GROUNDWATER QUALITY IN EAST ANGLIA,
British Geological Survey, Wallingford (England). Hydrogeology Research Group.
J. M. Parker, and R. C. James.
Journal of Applied Bacteriology (Symposium Supplement) JABAA4, p 15S-25S, 1985. 6 fig, 3 tab, 8 ref.

Descriptors: *Path of pollutants, *Water pollution sources, *Groundwater pollution, *Autochthonous bacteria, *Chalk aquifers, *England, *Groundwater, *Denitrification, Aerobic bacteria, Anaerobic bacteria, Substrates, Microbiological studies, Organic carbon.

The influence of active biodenitrification in a British chalk aquifer polluted with nitrates derived from leaching of fertilized farmland (Mattishall) is investigated through a bacteriological analysis of core samples. Anaerobic and aerobic bacteria were identified and denitrifying bacteria were characterized. The influence of organic substrate type and availability was determined and denitrification rates were calculated. It is concluded that the quality of low nitrate groundwater supplies in the East Anglian Chalk is controlled by the presence and activity of denitrifying bacteria and depends on a suitable supply of organic carbon substrate to maintain microaerophilic conditions. (Michael-PTT)
W87-02207

WATER CYCLE AS A SOURCE OF PATHOGENS,
North West Water Authority, Warrington (England).
F. Jones, and J. Watkins.
Journal of Applied Bacteriology (Symposium Supplement) JABAA4, p 27S-36S, 1985. 1 fig, 2 tab, 50 ref.

Descriptors: *Path of pollutanst, *Hydrologic cycle, *Pathogens, *Wastewater treatment, *Wastewater disposal, Wastewater, Effluents, Public health, Salmonella, Bacteria, Recreation, Water use.

The presence and movement of pathogenic organisms through the water cycle is discussed in terms of the development and application of wastewater disposal and treatment standards. Pathogenic agents in sewage effluent and sludge are identified and techniques to minimize salmonella survivability in various sewage treatement processes are discussed. The health implications of the presence of pathogenic microorganisms in sewage-contaminated waters used by domestic animals and for recreational purpoes are also presented. (Michael-PTT)
W87-02208

OCCURRENCE IN WATER OF VIRUSES OF PUBLIC HEALTH SIGNIFICANCE,
Welsh Water Authority, Powys.
J. Tyler.
Journal of Applied Bacteriology (Symposium Supplement) JABAA4, p 37S-46S, 1985. 67 ref.

Descriptors: *Public health, *Viruses, *Water supply, Contamination, Fresh water, Drinking water, Recreation, Epidemiology, Infection, Monitoring, Wastewater.

The occurrence of infectious viruses in water supplies, including wastewater, fresh water, drinking water and marine waters, is reviewed and the the infectivity of those viruses and epidemiology of waterborne virus diseases is described. Establishment of viral standards for potable, abstraction and

recreational water is discussed in terms of the effectiveness of the monitoring techniques needed to detect viruses in water. It is recommended that a data base be established to assess the public health significance and predict the hazards associated with viral pollution of water supplies. (Michael-PTT)
W87-02209

MATERIALS USAGE AND THEIR EFFECTS ON THE MICROBIOLOGICAL QUALITY OF WATER SUPPLIES,
Thames Water Authority, London (England).
For primary bibliographic entry see Field 5F.
W87-02210

INFECTIONS ASSOCIATED WITH WHIRLPOOLS AND SPAS,
North West Water Authority, Warrington (England).
F. Jones, and C. L. R. Bartlett.
Journal of Applied Bacteriology (Symposium Supplement) JABAA4, p 61S-66S, 1985. 42 ref.

Descriptors: *Water pollution sources, *Infection, *Whirlpools, *Spas, *Recreation, Epidemiology, Health effects, Pseudomonas aeruginosa, Disinfection, Chlorination, Water quality.

The epidemiology of infections caused by contaminated water in recreational spas and whirlpools is reviewed. Skin rashes, otitis externa and mastitis caused by Pseudomonas aeruginosa are the most commonly identified infections associated with whirlpools and spas. There is evidence that urinary tract and respiratory infections can also be caused by microbial contamination of these facilities. Disinfection measures such as chlorination and frequent cleaning are essential to maintaining adequate water quality in heavily used public whirlpools and spas. (Michael-PTT)
W87-02211

LONG TERM ASSESSMENT OF NON-HAZARDOUS OILFIELD WASTE PITS,
Tulane Univ., New Orleans, LA. Dept. of Environmental Health Sciences.
For primary bibliographic entry see Field 5E.
W87-02245

ASSESSMENT OF LONG-TERM SALINITY CHANGES IN AN IRRIGATED STREAM AQUIFER SYSTEM,
Geological Survey, Reston, VA.
L. F. Konikow, and M. Person.
Water Resources Research WRERAO, Vol. 21, No. 11, p 1611-1624, November 1985. 17 fig, 7 tab, 33 ref.

Descriptors: *Path of pollutants, *Groundnwater pollution, *Salinity, *Irrigation effects, *Arkansas River, *Colorado, *Aquifer systems, Aquifer characteristics, Aquifer testing, Irrigation practices, Parametric hydrology, Model studies, Statistical analysis, Prediction, Groundwater, Calibrations.

A solute transport model was applied to an 11-mile reach of the Arkansas River valley in southeastern Colorado to compute salinity changes in response to temporally and spatially varying stresses from irrigation. In 1973, the calibrated model predicted a two-three percent increase in groundwater salinity if the observed irrigation practices were continued. The study area was resampled in 1982 to determine if any long-term salinity changes were actually occurring. Nonparametric and parametric statistical tests indicated that a statistically significant increase in groundwater salinity occurred between the winters of 1971 and 1972, the model calibration period. Comparison of data from the winters of 1972 and 1982 did not indicate a significant net change in salinity during the 10-year period. Analysis of historical data supports the hypothesis that groundwater salinity has reached a long-term dynamic equilibrium in response to irrigation practices. Invalid model predictions of long-term salinity increases resulted because the calibration period occurred during a short-term annual trend in increasing salinity in the river which was not representative of the long-term trend. (Author's abstract)
W87-02273

ANALYSIS OF HYDRODYNAMIC DISPERSION IN DISCRETE FRACTURE NETWORKS USING THE METHOD OF MOMENTS,
Royal Inst. of Tech., Stockholm (Sweden). Dept. of Chemical Engineering.
A. Rasmuson.
Water Resources Research WRERAO, Vol. 21, No. 11, p 1677-1683, November 1985. 3 fig, 1 tab, 13 ref, append.

Descriptors: *Groundwater movement, *Path of pollutants, *Solute transport, *Hydrodynamics, *Geologic fractures, *Networks, Fissure water, Mathematical models, Mathematical equations, Statistical analysis, Channeling, Mixing, Radionuclides.

Hydrodynamic dispersion fissure rock fracture networks were modeled using the residence time distribution theory. Hydrodynamic dispersion in fissure networks is of prime importance in the calculation of radionuclide migration from a repository of spent nuclear fuel in granitic bedrock. The theoretical analysis shows that distribution of flow and retention times in the channels and their degree of connectivity have a strong impact on transport of a dissolved species in fracture rock. Such data, however, are largely not available. At least the first four statistical moments for system response are easily obtained even for complex networks. An equivalent dispersion coefficient can be calculated from the central second moment. The effect of channeling decreases in systems with many mixing steps. A criterion based on the coefficients of skewness and kurtosis is derived for cases where system response is in accordance with the diffusion-dispersion models. Examples demonstrated that this limit may not be obtained under realistic repository conditions in fissured rock. (Michael-PTT)
W87-02280

UNCERTAINTY IN PHOSPHORUS RETENTION, WILLIAMS FORK RESERVOIR, COLORADO,
Geological Survey, Denver, CO.
For primary bibliographic entry see Field 2H.
W87-02281

MODELING THE RATE-CONTROLLED SORPTION OF HEXAVALENT CHROMIUM,
Geological Survey, Denver, CO.
D. B. Grove, and K. G. Stollenwerk.
Water Resources Research WRERAO, Vol. 21, No. 11, p 1703-1709, November 1985. 8 fig, 1 tab, 24 ref.

Descriptors: *Sorption, *Chromium, *Path of pollutants, *Model studies, Mathematical equations, Simulation analysis, Alluvium, Diffusion, Solute transport.

The results of numerical simulations of rate-controlled sorption of hexavalent chromium on alluvium are presented. Coefficients for three rate-controlled mechanisms in the form of film, pore and particle diffusion were independently determined and compared with coefficients obtained by fitting curves to column effluent data. The use of rate equations to predict conservative transport and rate and local equilibrium controlled reactions was shown to be feasible. (Michael-PTT)
W87-02283

INCORPORATION OF POINT SOURCES IN NUMERICAL TRANSPORT SCHEMES,
Ministry of Works and Development, Hamilton (New Zealand). Water Quality Centre.
G. B. McBride.
Water Resources Research WRERAO, Vol. 21, No. 11, p 1791-1795, November 1985. 4 fig, 19 ref.

Descriptors: *Solute transport, *Path of pollutants, *Solutes, Oscillation, Advection, Dispersants, Numerical analysis, Mathematical equations, Model studies, Injection, Steady flow, Boundary conditions.

The incorporation of point sources into numerical transport schemes was investigated with particular reference to the Stone-Brian scheme. Equations were developed for the case of the advection/dispersion of a conservative solute in a one dimensional channel with a single point source. The analysis showed that substantial oscillations can be generated upstream of the fixed steep front at the source location in numerical experiments with the Stone-Brian numerical transport scheme for continuous point source injection into steady uniform flow. These occur because the scheme does not possess the transportive property. Oscillations are most severe when the point source massflow is allocated to a single grid node which can lead to gross mass conservation errors if the upstream boundary condition is not carefully specified. The importance of incorporating point sources in schemes that lack the transportive property is emphasized. (Michael-PTT)
W87-02295

STEADY STATE FLOW PASSING THROUGH A CYLINDER OF PERMEABILITY DIFFERENT FROM THE SURROUNDING MEDIUM,
Nevada Univ. System, Reno. Desert Research Inst.
For primary bibliographic entry see Field 2F.
W87-02308

AVAILABILITY OF PHOSPHORUS UPWELLING FROM IRON-RICH ANOXIC HYPOLIMNIA,
McGill Univ., Montreal (Quebec). Dept. of Biology.
For primary bibliographic entry see Field 2H.
W87-02310

WATER FLOW AND SOLUTE TRANSPORT PROCESSES IN THE UNSATURATED ZONE,
California Univ., Davis. Dept. of Land, Air and Water Resources.
For primary bibliographic entry see Field 2G.
W87-02319

SIMULATION OF NONAQUEOUS PHASE ORGANIC COMPOUNDS IN THE SUBSURFACE,
Princeton Univ., NJ. Dept. of Civil Engineering.
G. F. Pinder, and L. M. Abriola.
Water Resources Research WRERAO, Vol. 22, No. 9, p 109S-119S, August 1986. 10 fig, 2 tab, 31 ref. NSF Grant ECE-8451469.

Descriptors: *Path of pollutants, *Organic compounds, *Groundwater movement, *Solute transport, Model studies, Mathematical studies, Mathematical equations, Multiphase flow, Flow profiles, Groundwater pollution, Aquifers, Contamination.

The movement of nonaqueous phase organic liquids (NAPL) in a groundwater system involves both miscible and immiscible flow phenomena. A broad overview of the task of modeling these flows is presented along with a discussion of various problematic issues related to such a modeling effort. These issues can be loosely subdivided into three categories: those that pertain to the enhancement of our understanding of the physics of multiphase flows in groundwater systems; those that relate to the development of a data base of multiphase flow parameters; and those that relate to the development of numerical models to simulate multiphase contamination events. Descriptive equations are obtained through combination of the species balance equations for multiphase fluid flow in a porous medium and appropriate constitutive relationships. Tabulation and discussion of these constitutive relations yields insight into model requirements. Under certain assumptions, the modeling problem can be reduced to the solution of two nonlinear partial differential equations in two unknowns. An example simulation of the movement of NAPL emanating from two point sources in a confined aquifer is presented to illustrate present modeling capabilities. (Lantz-PTT)
W87-02320

REDUCTION OF CYANIDES BY THE NITROGENASE-SYSTEMS OF FREE-LIVING DIAZOTROPH BACTERIA IN THE SEDIMENT OF THE RIVER ALSTER (HAMBURG), (ABBAU VON CYANIDEN DURCH DIE NITROGENASEN FREILBENDER DIZOTROPHER BAKTERIEN IM ALSTERSEDIMENT (HAMBURG)),
Fachhochschule Hamburg (Germany, F.R.). Fachbereich Produktions- und Verfahrenstechnik.
D. Jaeger, and E. Dotterweich.
Archiv fuer Hydrobiologie AHYBAY, Vol. 107, No. 2, p 249-259, August 1986. 4 fig, 1 tab, 10 ref.

Descriptors: *Cyanide, *Path of pollutants, *Fate of pollutants, *Diazotroph bacteria, *River sediments, *Alster River, Hamburg, Germany, Nitrogen fixing bacteria, Enzymes, Anaerobic bacteria, Aerobic bacteria, Chemical reactions.

Studies on the reduction of cyanides by the nitrogenase systems of free-living nitrogen-fixing bacteria revealed that the enzyme activity is influenced by the presence of cyanides, and that a correlation between nitrogenase-activity (acetylene reduction) and cyanide-reduction exists. At cyanide concentrations between 0.5 and about 75 mg CN(-)/kg sludge, the anaerobic acetylene reduction increased and was inhibited by higher cyanide-concentrations added to samples. The highest biological cyanide-reduction occurred at a concentration of 5 mg CN(-)/kg sludge. Within a 66-hr incubation time, at least 50% of the cyanides were reduced to CH4 and NH3 by facultative and obligate anaerobic bacteria and about 22% by aerobic diazotroph bacteria. (Author's abstract)
W87-02345

AEROBIC UPTAKE OF FE(III)-PRECIPITATED PHOSPHORUS BY MICROORGANISMS,
Lund Univ. (Sweden). Limnological Inst.
For primary bibliographic entry see Field 2H.
W87-02346

BIOLOGICAL FATE OF ORGANIC PRIORITY POLLUTANTS IN THE AQUATIC ENVIRONMENT,
Pennsylvania Univ., Philadelphia. Dept. of Civil and Urban Engineering.
D. J. Richards, and W. K. Shieh.
Water Research WATRAG, Vol. 20, No. 9, p 1077-1090, September 1986. 4 fig, 6 tab, 63 ref.

Descriptors: *Biological properties, *Fate of pollutants, *Priority pollutants, *Path of pollutants, *Organic compounds, *Literature reviews, Biological degradation, Wastewater treatment, Sludge, Waste disposal.

This is a review of the literature on the fate of the organic priority pollutants in the aquatic environment including biological wastewater treatment systems. Included is a brief discussion of the biological processes - mineralization, cometabolism, bioaccumulation and polymerization - and conditions under which biodegradation occurs. In essence, the evidence indicates that, under proper conditions, many of these pollutants can be biologically degraded, especially with a great variety of microorganisms present in the system. The fact that biological wastewater treatment facilities harness heterogeneous microbial populations to induce required treatment could prove to be significant in the assessment of the fate of the organic priority pollutants in the aquatic environment. It is also conceivable that, with rapid progress in genetic engineering as well as improved knowledge about metabolic pathways for the degradation of priority pollutants by different microorganisms, the degradability of these facilities could drastically be improved and complemented. But of equal importance may be the improving of existing biological wastewater treatment facilities with the incorporation of more conventional technologies such as the addition of powder activated carbon and ozonation. The tendency of more recalcitrant organic priority pollutants to concentrate in the solid phase such as sludge streams in wastewater treatment facilities may have significant implications on the treatment of sludges and their ultimate disposal in the environment. The investigation on the fate of the organic priority pollutants in this system could provide valuable information that is much needed. Finally, improved quantitative methodologies for laboratory and field investigations should be developed to provide better insight into the complex nature of the biological fate of the organic priority pollutants in the aquatic environment. (Lantz-PTT)
W87-02354

TOTAL MERCURY, METHYL MERCURY AND SULPHIDE LEVELS IN BRITISH ESTUARINE SEDIMENTS - III,
Leicester Polytechnic (England). School of Chemistry.
P. J. Craig, and P. A. Moreton.
Water Research WATRAG, Vol. 20, No. 9, p 1111-1118, September 1986. 2 fig, 5 tab, 20 ref.

Descriptors: *Mercury, *Methyl mercury, *Sulfides, *Estuaries, *Sediments, *South West River, *Clyde Estuary, *Mersey Estuary, England, Scotland, Carron River, Oxidation, Reduction, Biomethylation, Fate of pollutants.

Results from large scale studies of British estuaries (South West Rivers, Clyde, Mersey) for mercury, methyl mercury, sulfide and Eh levels are presented. The importance of sulfide concentrations in sediments as a controlling factor for methyl mercury levels is demonstrated for these locations. The data showing methyl mercury concentrations for most of the locations discussed has not been available previously. As was found previously for the River Carron, Scotland, above a sulfide concentration of about 3.0 mg/g in River Clyde sediments, methyl mercury levels present decline as sulphide further increases. Below 3.0 mg/g (sulfide), methyl mercury levels increase as sulfide concentrations increase. (Author's abstract)
W87-02357

EFFECTS OF HYPOLIMNETIC AERATION ON IRON-PHOSPHORUS INTERACTIONS,
York Univ. (England). Dept. of Biology.
For primary bibliographic entry see Field 5G.
W87-02359

ORGANIC INDICATORS OF GROUNDWATER POLLUTION BY A SANITARY LANDFILL,
Consejo Superior de Investigaciones Cientificas, Madrid (Spain).
For primary bibliographic entry see Field 5A.
W87-02362

SUSPENDED SEDIMENT PHOSPHORUS COMPOSITION IN TRIBUTARIES OF THE OKANAGAN LAKES, B.C.,
National Water Research Inst., Vancouver (British Columbia).
C. B. J. Gray, and R. A. Kirkland.
Water Research WATRAG, Vol. 20, No. 9, p 1193-1196, September 1986. 1 tab, 22 ref.

Descriptors: *Suspended sediments, *Phosphorus, *Okanagan Lakes, *British Columbia, Inorganic compounds, Organic compounds, Algae, Eutrophication.

The phosphorus composition of suspended sediments tranported during snowmelt to the Okanagan lakes averaged 62% apatite P, 16% non-apatite inorganic P (NAIP), and 22% organic P. Based on the average NAIP content, less than 16% of these P inputs were available for algal growth in the lakes. The content of NAIP in some stream suspended sediments was much higher than average, however. Management of the suspended sediment inputs to reduce P loadings will be most effective if applied to those tributaries contributing the most NAIP. (Author's abstract)
W87-02366

DEGRADATION OF TERBUFOS IN SOIL AND ITS TRANSLOCATION INTO COLE CROPS,
S. Y. Szeto, M. J. Brown, J. R. Mackenzie, and R. S. Vernon.
Journal of Agricultural and Food Chemistry JAFCAU, Vol. 34, No. 5, p 876-879, September-October 1986. 1 fig, 4 tab, 14 ref.

Descriptors: *Insecticides, *Path of pollutants, *Cole crops, *Soil contamination, *Fate of pollutants, *Terbufos, Silt, Loam, Fensulfothion, Chlorfenvinphos, Diazinon, Broccoli, Cabbage, Cauliflower, Translocation.

When terbufos at 1.9 g of AI/10-m row was applied to a silt loam soil at seeding for cabbage maggot control, its effectiveness was comparable to, or better than, that of the registered chemicals fensulfothion, chlorfenvinphos and diazinon. Terbufos oxidized to its sulfoxide and sulfone in soil. The calculated half-lives of terbufos and total residues were 15 and 22 days, respectively. The total residues in soil were less than 1.0 ppm after 106 days. Terbufos translocated from soil into broccoli. The plant residues consisted mostly of terbufos sulfoxide, terbufos oxon sulfoxide, and terbufos sulfone, but the parent compound accounted for only 5% of the total. After 57 days there were 0.43 ppm total residues in the plant but only traces (< 0.01 ppm, fresh weight) in the marketable heads of broccoli harvested 90 days after seeding. In marketable cabbage and cauliflower grown and treated and harvested in the same way, total residues ranged from nondetectable to trace. (Author's abstract)
W87-02371

DEGRADATION OF CIS- AND TRANS-PERMETHRIN IN FLOODED SOIL,
Maryland Univ., College Park. Dept. of Botany.
E. G. Jordan, and D. D. Kaufman.
Journal of Agricultural and Food Chemistry JAFCAU, Vol. 34, No. 5, p 880-884, September-October 1986. 4 tab, 12 ref.

Descriptors: *Path of pollutants, *Soil contamination, *Fate of pollutants, *Permethrin, *Saturated soils, Chemical analysis, Chemical degradation, Radioactive carbon, Silt, Loam, Thin layer chromatography.

The degradation of permethrin was studied in a flooded Memphis silt loam soil incubated at 25 C. Trans-, and cis-permethrin were added to soil at rates of 0.1 and 1.0 ppm. Soils were analyzed after 0, 4, 8, 16, 32, and 64 days to determine the distribution of 14-C in CO2, solvent-extractable compounds, water-soluble polar compounds, and soil-bound residues. Thin-layer chromatographic analysis of the organic solvent extracts showed that trans-permethrin was more rapidly degraded than cis-permethrin. Two metabolites, 3-(2,2-dichlorovinyl)-2,2-dimethyl-cyclopropanecarboxylic acid (DCVA) and 3-phenoxybenzyl alcohol (PBalc), which resulted from permethrin hydrolysis, were identified. Other metabolites identified were 3-phenyoxybenzoic acid (PBacid) and 3-phenoxybenzaldehyde (PBald), an intermediate in the conversion of PBalc to PBacid. Fragmentation of DCVA and PBacid to CO2 was not extensive, and cumulative 14-CO2 recoveries were less than 3.5% for all treatments during the 64-day incubation period. Metabolism of trans-permethrin resulted in the accumulation of polar compounds in the water. Soil-bound residues gradually increased with time and accounted for 3.3-11.4% of the 14-C activity after 64 days. The largest percentage of soil-bound 14-C residue was in the fulvic acid fraction. (Author's abstract)
W87-02372

STORM WATER POLLUTION MODELLING: FIRST-ORDER ATMOSPHERIC DUSTFALL PROCESSES THAT AFFECT RUNOFF QUALITY,
McMaster Univ., Hamilton (Ontario). Dept. of Civil Engineering and Engineering Mechanics.
For primary bibliographic entry see Field 5G.
W87-02377

ROLE OF ORGANIC ACIDS IN THE ACID-BASE STATUS OF SURFACE WATERS AT BICKFORD WATERSHED, MASSACHUSETTS,
Masssachusetts Inst. of Tech., Cambridge. Ralph M.

Parsons Lab. for Water Resources and Hydrodynamics.
For primary bibliographic entry see Field 2H.
W87-02380

CAMPERS' DIARRHEA OUTBREAK TRACED TO WATER-SEWAGE LINK,
Centers for Disease Control, Atlanta, GA. Epidemiology Program Office.
K. M. Starko, E. C. Lippy, L. B. Dominguez, C. E. Haley, and H. J. Fisher.
Public Health Reports, Vol. 101, No. 5, p 527-531, September-October 1986. 2 fig, 3 ref.

Descriptors: *Diarrhea, *Water pollution sources, *Wastewater, *Water pollution effects, *Water pollution, Sewage bacteria, Wastewater irrigation, Potable water, Drinking water, Arizona.

From June through September 1979, diarrheal illness occurred in an estimated 1,850 persons who had camped at a private campground in Arizona. Illness occurred more frequently among campers at that campground than among those in the adjacent State park ($P < 0.0001$). The same well served both the private and the State campgrounds as the source of drinking water, but that water was distributed to the two campgrounds through separate lines. Illness was significantly associated with drinking water at the campsite ($P < 0.0001$), drinking water quantities of campsite water ($P < 0.001$), and camping on the southwest side of the campground ($P < 0.001$). Samples of the water collected from the system during January through June contained no coliform bacteria. However, all those samples had been collected from the State park only. Of the 11 water samples submitted for bacteriological analyses during the summer, 3 had high levels of bacteria. Excavation of the water system uncovered a direct cross connection between the potable water system and a sewage-effluent irrigation system. (Author's abstract)
W87-02388

HEAVY METALS IN THE SEDIMENTS OF THE LOIRE ESTUARY (METAUX LOURDES DANS LES SEDIMENTS DE L'ESTUAIRE DE LA LOIRE),
Nantes Univ. (France).
D. Robbe, P. Marchandise, and D. Gouleau.
Water Research WATRAG, Vol. 19, No. 12, p 1555-1563, December, 1985. 8 fig, 3 tab, 31 ref.

Descriptors: *Heavy metals, *Sediments, *Path of pollutants, *Loire River, *Estuaries, Organic carbon, Sedimentation, Wastewater disposal, Water sampling, Volatile solids, Seasonal variation, Solubility, Salinity, Mixing, Marine sediments, Adsorption.

The origin and evolution of heavy metals in sediments of the Loire River estuary were studied. Two series of samples were taken at 19 selected points along the estuary. The uniformity of metal element contents indiciated localized impact of significant discharges, except in the case of discharges from the city of Nantes. The seasonal evolution of sediment metal characteristics was demonstrated. Only limited enrichment or depletion ocurred at any point over a period of time. Variations in the composition of the sediment did not reflect alterations in the metallic flux over the sediment, rather the capacity of sediment to trap polluting flux was according to its own composition. Reduction of metal contents during estuarial transit was attributed to the chemical properties of specific metal elements. Stabilization played only a secondary role in upstream-downstream reductions because of the low percentages of metal adsorbed by the sediment in relation to total metals content. Disappearance of metals associated with organic matter was attributed to salinity. Reduction of metal content of the lower estuary occurred downstream of the salinity front where the first sediment characteristics of the marine environment occured. Mixing of metal-laden fluvial sediments with relatively clean marine sediments may be responsible for reducing metallic elements content of the river sediment. (Michael-PTT)
W87-02400

DENITRIFICATION RATES IN RELATION TO STREAM SEDIMENT CHARACTERISTICS,
York Univ., North York (Ontario). Dept. of Geography.
A. R. Hill, and K. Sanmugadas.
Water Research WATRAG, Vol. 19, No. 12, p 1579-1586, December, 1985. 2 fig, 5 tab, 33 ref.

Descriptors: *Path of pollutants, *Fate of pollutants, *Denitrification, *Fluvial sediments, Nitrates, Ontario, Rivers, Ammonium, Organic carbon, Nitrogen, Solubility.

Potential rates of nitrate removal in sediments from three Ontario rivers differing in texture, organic carbon contents and other characteristics were studied. Sediment cores from 22 sites on each river were overlain and aerated with NO3(-)-N solution and incubated at 21 C for 48 hours. Rates of nitrate-N loss varied during a 24 hour period. Acetylene blockage was used with nitrate amended sediments to evaluate the relative importance of denitrification and nitrate reduction to ammonium. Denitrification accounted for most of the nitrate loss in the majority of the sediments tested. Nitrate loss rates were positively correlated with the water soluble carbon content of the sediments in each river. Significant relationships were also noted between nitrate loss and organic carbon, total nitrogen and sediment ammonium. Nitrate loss via denitrification and increased nitrate reduction to ammonium was correlated with the organic carbon and water soluble carbon content of the stream sediments. (Author's abstract)
W87-02402

EMPIRICAL MODEL FOR DISAPPEARANCE OF FREE OXIDANTS IN NATURAL WATER WITH WIDE SALINITY AND AMMONIA RANGES,
Osaka City Inst. of Public Health and Environmental Sciences (Japan).
K. Yamamoto, M. Fukushima, S. Kawai, and T. Yamamoto.
Water Research WATRAG, Vol. 19, No. 12, p 1595-1599, December, 1985. 7 fig, 26 ref.

Descriptors: *Oxidation, *Salinity, *Path of pollutants, *Fate of pollutants, *Ammonia, Chlorine, Seawater, Rivers, Organic compounds, Inorganic compounds, Chemical reactions, Mathematical models, Mathematical equations.

An empirical model for the disappearance rates of chlorine-induced free oxidants in natural water was developed. This disappearance occurs in two stages in both river water and seawater. The disappearance of free oxidants in the second stage was due to consumption by organic substances and could be empirically explained by a second-order reaction of oxidants. The rate constant decreased with an increase of the oxidant concentration after subtracting the decrease in the first stage from the chlorine dose. In seawater, maximum persistence of oxidants could be estimated by the self-decomposition rate of hypobromite and the rate constant could be obtained as a function of the bromide concentration. Rapid disappearance in the first stage was caused by reactions with reactive inorganic and organic substances in the water. The minimum decrease, which was led to the maximum persistence in the second stage, could be expressed as consumption by ammonia. Maximum persistence of free oxidants in natural water with wide salinity and ammonia ranges could be estimated using this model. (Author's abstract)
W87-02404

NITROGEN-ISOTOPE STUDY OF THE SOURCES OF NITRATE CONTAMINATION IN GROUNDWATER OF THE PLEISTOCENE COASTAL PLAIN AQUIFER, ISRAEL,
Weizmann Inst. of Science, Rehovoth (Israel). Dept. of Isotope Research.
N. Kaplan, and M. Magaritz.
Water Research WATRAG, Vol. 20, No. 2, p 131-135, February, 1986. 1 fig, 3 tab, 24 ref. NSF Grant EAR 815985.

Descriptors: *Nitrogen isotopes, *Nitrates, *Path of pollutants, *Groundwater pollution, *Israel, Wastewater disposal, Fertilizers, Oxidation, Organic matter, Agricultural runoff, Land reclamation.

Concentrations and sources of NO3(-) in phreatic groundwater in Israel's Coastal Plain aquifer were examined in a nitrogen isotope study. The possibility of NO3(-) derivation from fertilizer application or from utilization of sewage treatment water for irrigation is investigated. Isotopic data were consistent with a model presented by other authors which suggested that the main sources of NO3(-) groundwater contamination are from oxidation of organic matter during cultivation of virgin land and from swampland reclamation activities. (Michael-PTT)
W87-02406

DESCRIPTION OF THE AGGREGATION PROPERTIES OF AQUATIC PEDOGENIC FULVIC ACIDS: COMBINING PHYSICOCHEMICAL DATA AND MICROSCOPIAL OBSERVATIONS,
National Water Research Inst., Burlington (Ontario). Aquatic Ecology Div.
G. G. Leppard, J. Buffle, and R. Baudat.
Water Research WATRAG, Vol. 20, No. 2, p 185-196, February, 1986. 9 fig, 1 tab, 53 ref.

Descriptors: *Fulvic acids, *Aggregation, Physicochemical properties, Transmission electron microscopy, Organic matter, Particle size, Dehydration, Ultrafiltration.

Water fulvic acids containing pedogenic refractory organic matter (PROM) are discussed in terms of physicochemical properties and photomicrographic data using transmission electron microscopy (TEM) applied to ultrathin sections of embedded PROM. Physicochemical data indicates that aggregation occurs at PROM concentration of less than 200 mg/l and that the size of non-aggregated molecules is close to 1 nanometer (nm). The size of molecules adsorbed at some interfaces is smaller, possibly as a result of dehydration. TEM identified particles less that 2-3 nm which may be due to limited resolution of TEM and/or possible aggregation occurring during sample preparation. Microscopical observation showed that most PROM fraction is composed of 3 nm granules, either isolated or aggregated to larger entities. The aggregates can pass ultrafiltration membranes even when aggregates size is larger than pore size. An integrated interpretation suggests, that in surface water, PROM can form a continuum of aggregated particles which vary widely in size. Dehydration may occur at the surface making aggregation less reversible. It is concluded that ultrafiltration is not always a simple process when applied to water rich in fulvic acids, and it could become unreliable if colloid formation is not controlled. (Author's abstract)
W87-02412

STATIC SHAKE-FLASK BIOTRANSFORMATION OF ENDOTHALL,
North Texas State Univ., Denton. Dept. of Biological Sciences.
K. H. Reinert, J. H. Rodgers, T. J. Leslie, and M. L. Hinman.
Water Research WATRAG, Vol. 20, No. 2, p 255-258, February, 1986. 2 fig, 4 tab, 21 ref.

Descriptors: *Fate of pollutants, *Aquatic herbicides, *Biotransformation, Biodegradation, Reservoirs, Aquatic weed control, Hazards.

Laboratory biotransformation and biodegradation rate coefficients were determined for endothall, an aquatic herbicide, concentrations of which were employed in a static shake-flask test containing reservoir water. A pseudo-first-order rate coefficient and the aqueous half-life were determined. Test results support endothall as an environmentally labile herbicide with respect to biotransformation. This suggests that there is an adequate safety margin for endothall application in aquatic environments. (Author's abstract)
W87-02420

PARAUARI - MAUES - ACU RIVER BASIN, CHEMICAL CHARACTERISTICS CAUSED BY HYDROLOGIC CHANGES IN THE BASIN, (BACIA DO RIO PARAUARI - MAUES - ACU: ASPECTOS QUIMICOS AS ALTERACOES HIDROLOGICAS DA BACIA),
Instituto Nacional de Pesquisas da Amazonia, Manaus (Brazil).
For primary bibliographic entry see Field 2K.
W87-02429

RIVERS OF THE AMAZON BASIN. I. TRIBUTARIES OF THE RIO NEGRO, (RIOS DA BACIA AMAZONICA. I. AFLUENTES DO RIO NEGRO),
Instituto Nacional de Pesquisas da Amazonia, Manaus (Brazil).
U. de M. Santos, S. R. B. Bringel, H. Bergamin, M. de N. G. Ribeiro, and M. Bananeira.
Acta Amazonica, Vol. 14, No. 1/2, p 222-237, March-June 1984. 1 fig, 5 tab, 15 ref.

Descriptors: *Amazon Basin, *Rio Negro, *Metals, *Physicochemical properties,*Hydrogen ion concentration, *Water pollution sources, *Water quality, Organic compounds, Nutrients, Fertilizers, Macrophytes, River systems, Nitrogen.

Water samples from twenty-nine tributaries of the Rio Negro were analysed and compared according to their physico-chemical qualities. The majority of the tributaries were very poor in dissolved minerals and highly acidic. A significant relationship was found between the level of colored organic substances and several chemical parameters. The left bank affluents, originating from the mountains in the North, had higher nutrient levels, while the right bank affluents, the majority of which originate in swampy lands or podzol soils were considered extremely poor. In general, physical, chemical, and biological conditions affect the nitrogen values. The recent fertilization of flooded areas and the appearance of aquatic macrophytes in the lower Negro are discussed. (Author's abstract)
W87-02451

SECOND ANNUAL EASTERN REGIONAL GROUND WATER CONFERENCE.
National Water Well Association, Worthington, OH.
For primary bibliographic entry see Field 2F.
W87-02437

STEP-BY-STEP APPROACH TO GROUNDWATER CONTAMINATION PROBLEMS,
Massachusetts Dept. of Environmental Quality Engineering, Boston.
D. S. Brownlee.
IN: The Second Annual Eastern Regional Ground Water Conference, July 16-18, 1985, Portland, Maine. 1985. p 1-24, 4 fig, 1 ref.

Descriptors: *Groundwater pollution, *Water quality control, *Site assessments, Handbooks, Geohydrology, Regulations, Hazardous wastes, Standards, Waste disposal, Path of pollutants, Groundwater movement, Massachusetts.

Hydrogeologic reports of site investigations at hazardous chemical waste sites are being prepared by professional engineering and geological consultants in response to groundwater monitoring programs mandated by the Resource Conservation and Recovery Act (RCRA) and the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA, better known as Superfund). Too many of these reports have failed to address, in a professionally competent manner, the problems associated with a particular site. Much time and money is being wasted by private industry and public agencies on inadequate studies by unqualified consultants. Too often, as reviewer, the author's final comment was 'Reviewed and rejected.' In order to correct this situation in Massachusetts, the author wrote a basic handbook designed to meet the needs of environmental engineers employed by the state, who were expected to evaluate hydrogeologic studies conducted to monitor or investigate groundwater contamination problems. It was also written as guidance for consultants who design and conduct such studies. In this paper, the author describes a step-by-step approach to groundwater contamination problems. Although the handbook was written primarily for environmental engineers working in the RCRA licensing program, the methodology is equally applicable to hydrogeologic investigations of all hazardous waste sites, including Superfund sites, as well as solid waste disposal areas. A checklist for a standardized approach to a groundwater contamination problem is included. (See also W87-02437) (Author's abstract)
W87-02438

HAZARDOUS WASTE SITE ASSESSMENT ON A 'BARE BONES' BUDGET,
Wright Water Engineers, Inc., Denver, CO.
J. E. Jones.
IN: The Second Annual Eastern Regional Ground Water Conference, July 16-18, 1985, Portland, Maine. 1985. p 25-35.

Descriptors: *Hazardous wastes, *Site assessments, *Waste disposal, *Water quality control, *Cost analysis, Water pollution effects, Water pollution sources, Water quality management, Environmental effects, Regulations.

An unknown number of hazardous waste sites have not been formally identified, let alone professionally evaluated. Such sites are not on federal or state Superfund priority lists, nor do they have industries charged with mitigating off-site impacts from them. Many of these sites are in rural communities where site assessment funding is limited, particularly at the initial investigatory level. In cases where a community suspects that it may have a hazardous problem, how can the community undertake a reconnaissance level site evaluation which: (1) requires the expenditures of only modest local funds, (2) minimizes safety hazards to those citizens who choose to assist in the site evaluation process, and (3) produces information of sufficient detail, breadth, and accuracy to enable state and/or federal authorities to authorize funding for detailed site evaluation. This paper attempts to answer these questions by delineating simple and inexpensive steps that a community can take to preliminary assess the probable magnitude of risk posed by a hazardous waste site. Reconnaissance level investigations undertaken by a community are valuable in three respects: (1) The community immediately addresses a local concern without waiting for state or federal assistance, and enhances the likelihood of receiving financial assistance for further evaluation, if required; (2) State and federal regulatory agencies obtain background information that expedites their site assessment; and (3) In the event that state and federal financing for further investigation is not forthcoming, the reconnaissance level work will enable professionals retained by the community to develop a sensible methodology for apportioning limited local funding for detailed site analysis. (See also W87-02437) (Lantz-PTT)
W87-02439

SITE ASSESSMENTS TO DETERMINE THE PRESENCE OF HAZARDOUS MATERIALS,
Rizzo Associates, Inc., Natick, MA.
For primary bibliographic entry see Field 5G.
W87-02440

APPLICATION OF QUALITATIVE RISK ASSESSMENT TO ASSIST IN EVALUATING REMEDIAL ACTION ALTERNATIVES,
Camp, Dresser and McKee, Inc., Boston, MA.
For primary bibliographic entry see Field 5G.
W87-02441

HYDROGEOCHEMISTRY OF RADON IN GROUND WATER,
Maine Geological Survey, Augusta.
For primary bibliographic entry see Field 2K.
W87-02442

RADON GAS IN GROUND WATER OF NEW HAMPSHIRE,
Minnesota Univ., St. Paul.
F. R. Hall, P. M. Donahue, and A. L. Eldridge.
IN: The Second Annual Eastern Regional Ground Water Conference, July 16-18, 1985, Portland, Maine. 1985. p 86-101, 6 fig, 1 tab, 19 ref.

Descriptors: *Groundwater pollution, *Radon, *New Hampshire, Toxicity, Geohydrology, Geochemistry, Glacial drift, Metamorphic rocks, Quartz, Granite, Radioisotopes, Radioactive tracers, Uranium, Radium, Path of pollutants, Pumping, Chloride, Specific conductivity, Iron.

Hydrologic, chemical, and geologic factors all influence radon content in groundwater. It is difficult to assess which factors are the more significant under a given set of conditions except that bedrock type is very important. This importance is due to the abundance of the parent isotopes of uranium and radium and their availability for dissolution and transport and possible precipitation by circulating groundwater. Nevertheless, the relationships between bedrock type and the other factors are not always simple. The general results from single samples from many wells are: (1) Average radon content is highest in two-mica granite, followed by quartz monzonite, Conway Granite, high grade metamorphics, low grade metamorphics, diorites, and glacial deposits; (2) Radon increased significantly with metamorphic grade in rocks of the Merrimack Group; (3) Pegmatites are a probable source of radon in high grade metamorphic rocks and those in the New Hampshire succession; (4) Chloride, specific conductance, and iron show an inverse relationship to radon content; and, (5) Radon content decrease with increasing well yield or pumping rate in most of the rock types. The results of the more detailed sampling with time for selected wells and in the two-mica granite are in agreement with the first three conclusions, but they indicate that the relationships outlined in the last two are not always so evident. (See also W87-02437) (Lantz-PTT)
W87-02443

EFFECTS OF SUBURBAN DEVELOPMENT ON THE GROUNDWATER OF THE STOCKTON FORMATION BUCKINGHAM TOWNSHIP, BUCKS COUNTY, PENNSYLVANIA,
Woodward-Clyde Consultants, Plymouth Meeting, PA.
For primary bibliographic entry see Field 4C.
W87-02444

WATER-QUALITY IN SAND AND GRAVEL AQUIFERS IN MAINE: THE INFLUENCE OF ACID DEPOSITION, AGRICULTURE, AND OTHER NON-POINT CONTAMINATION SOURCES,
Maine Dept. of Environmental Protection, Augusta.
J. S. Williams, and A. L. Tolman.
IN: The Second Annual Eastern Regional Ground Water Conference, July 16-18, 1985, Portland, Maine. 1985. p 123-135, 6 tab, 13 ref.

Descriptors: *Groundwater quality, *Groundwater pollution, *Acid rain, *Agriculture, *Nonpoint pollution sources, Aquifers, Sand, Gravel, Monitoring, Observation wells, Chemical analysis, Calcium, Agricultural runoff, Bicarbonates, Alkalinity, Bedrock, Waterville, Maine, Hydrogen ion concentration, Dissolved solids.

To determine background water quality in sand and gravel aquifers in south-central Maine, 79 monitoring wells have been installed in areas upgradient of any known point sources of contamination. Fifty-four of these wells are apparently unaffected by any land-use activities, but are subjected to atmospheric deposition of pollutants and acids. Twenty-five wells have been affected by nonpoint pollution sources such as agriculture, road salting and housing developments. Groundwater in the wells not affected by land-use activities was found to have very low levels of dissolved solids. Calcium concentrations in most wells were well below 10 mg/L. Other cations are generally found in concentrations below 5 mg/L, with chloride and sulfate levels ranging from <0.5 to 10 mg/L, and

nitrate concentrations from <0.01 to 0.5 mg/L. Bicarbonate alkalinity ranged from 3 to 61 mg/L as CaCO3, except in a small area near Waterville, where alkalinity values exceeded 100 mg/L. No volatile organic compounds were detected in these wells. The pH in these 54 samples ranges from 5.3 to 8.6. The lowest pH values were from southwestern Maine, where the aquifers are underlain by non-calcareous crystalline bedrock, and the mean annual precipitation pH is 4.3. Because there are no reliable long-term records on groundwater pH in western Maine, it is not known whether groundwater in this area is naturally acidic or is affected by acid deposition. The most prevalent nonpoint source contamination is associated with agricultural practices. Seventeen wells installed in agricultural fields in western and central Maine had a mean nitrate concentration of 7.98 mg/L, approximately 50 times the mean level in the background levels in these wells, but a preliminary scan in 4 of the 19 wells did not detect any pesticides. (See also W87-02437) (Lantz-PTT)
W87-02445

UNDERGROUND TANKS THREATEN GROUND WATER QUALITY,
Massachusetts Audubon Society, Lincoln.
A. O'Donnell.
IN: The Second Annual Eastern Regional Ground Water Conference, July 16-18, 1985, Portland, Maine. 1985. p 138-144, 9 ref.

Descriptors: *Groundwater pollution, *Water pollution sources, *Water quality control, Regulations, Storage tanks, Corrosion, Leakage, Landfills, Lagoons, Gasoline, Brines.

Leaking underground storage tanks have recently become the focus of much attention throughout New England and the nation. EPA has reported that the New England states have ranked underground storage tanks as the most serious groundwater contamination problem in the region, a dubious distinction shared only with landfills, lagoons, and chemical and brine spills. Underground storage tanks pose a major threat to groundwater quality because of their proximity to the water table, the high probability of leakage, the number of toxic compounds stored underground, the sheer number of tanks that exist or have been abandoned, and the lack of pertinent data and regulations. Estimates of the number of underground storage tanks nationwide vary between 1.5 and 10 million. Leakage estimates also vary. While current leakage probabilities range from 1 to 20%, there is little doubt that the rate is increasing. Some experts predict that 29% of all tanks will be leaking by mid-1987. Using EPA's estimates and conservative assumptions of average product loss per leakage incident, over 12 trillion gallons of groundwater are contaminated annually by leaking underground gasoline tanks throughout the U.S. Of the multitude of products stored in underground tanks, gasoline constitutes the greatest proportion. Several steps can be taken to reduce the risk of groundwater contaminstion from underground storage tanks. The first step is to locate and remove all abandoned tanks. In addition, new tanks must be carefully installed, and both tanks and pipes must be protected from corrosion. A number of corrosion-resistant linings, cathodic protection systems, double-walled tanks, and fiberglass tanks are available and are presumed to effectively reduce the risk of leakage. Some states have adopted underground storage regulations, but the majority have inadequate regulations or none at all. Approximately one-third of all states have regulations specifically designed to protect water resources; one-third have regulations to prevent against fire and explosion only; and the remaining one-third have no enforceable regulations governing underground storage tanks. In some states, such as Massachusetts, where regulations do not pertain to groundwater, several cities and towns have passed local regulations, bylaws, or ordinances. (See also W87-02437) (Lantz-PTT)
W87-02446

SUBSURFACE MONITORING TECHNIQUES FOR THE DETECTION OF LEAKS NEAR GASOLINE UNDERGROUND STORAGE TANKS,
New Hampshire Water Supply and Pollution Control Commission, Concord.
M. A. Sills, W. C. Carlson, and A. G. Swan.
IN: The Second Annual Eastern Regional Ground Water Conference, July 16-18, 1985, Portland, Maine. 1985. p 182-198, 7 fig, 1 tab, 3 ref.

Descriptors: *Monitoring, *Underground waste disposal, *Leakage, *Gasoline, *Water pollution sources, *Groundwater pollution, Water pollution treatment, Aquifers, Pumps, Bailers.

The state of New Hampshire has developed a patterned and phased program for the identification of the source of underground leaks once they have occurred. The basic elements of the program include: initial response and emergency clean-up activities; windshield survey of the study area; tank inventory and on-site visit, historical records search and data collection; development of a preliminary leak detection and subsurface monitoring strategy; soil gas monitoring surveys of the study area; installation of borings and overburden and bedrock aquifer monitoring wells and the use of various analytical techniques to define the affected soil and groundwater as well as compare the characteristics of a free floating product to those petroleum products currently being stored within the study area. It should be emphasized that because this program is essentially an emergency response in nature, it may, be necessity, contain all or a combination of the aforementioned techniques. Therefore, a more detailed technical and hydrogeological effort will normally be needed once the source(s) of contamination is initially identified and long term remedial management efforts are under way. The primary subsurface contamination detection methods used in the program include: soil gas monitoring and overburden and bedrock aquifer monitoring. Sampling of the free floating product and groundwater is accomplished with various bailers, pumps and packer systems, while estimating the thickness of free floating products can be accomplished with manual plunkers and conductivity and optical sensors. The major analytical methods utilized are portable gas vapor detection monitors (Hnu); portable gas chromatography as well as laboratory gas chromatography/mass spectroscopy apparatus for organic analyses and various inorganic analysis techniques to detect the presence of characteristic additives. A case study of a large underground gasoline spill in Plymouth, NH is used to demonstrate the applications and limitations of these techniques in identifying potential sources of underground gas leaks as well as their feasibility for use as leak detection methods for existing facilities. (See also W87-02437) (Lantz-PTT)
W87-02450

APPLICATION OF SURFACE GEOPHYSICS TO GROUND WATER MANAGEMENT PLANNING,
Weston (Roy F.), Inc., West Chester, PA.
For primary bibliographic entry see Field 5G.
W87-02453

ELECTRICAL RESISTIVITY/TERRAIN CONDUCTIVITY SURVEYS TO TRACE PROCESS WASTEWATER LEACHATE IN GROUNDWATER FROM A SPRAY IRRIGATION SYSTEM,
Jordan Gorrill Associates, Portland, ME.
For primary bibliographic entry see Field 7B.
W87-02454

MONITORING PLUME MIGRATION USING GROUND SURFACE CONDUCTIVITY,
Empire-Thomsen, Groton, NY.
M. B. Rinaldo-Lee, and R. Wagner.
IN: The Second Annual Eastern Regional Ground Water Conference, July 16-18, 1985, Portland, Maine. 1985. p 252-260, 5 fig, 1 ref.

Descriptors: *Monitoring, *Path of pollutants, *Conductivity, *Groundwater pollution, Waste disposal, Leachates, Groundwater movement, Leaking, Water pollution sources, Sludge, Groundwater quality.

Monitoring the migration of a contaminant plume is required at many waste disposal sites where groundwater contamination has been found. This ground conductivity survey corroborated earlier studies which indicated leachate was entering the groundwater flow regime via discharge pipes from an ash disposal site into an unlined drainage ditch south and southwest of the ash disposal site. Leakage from the surface water discharge pipe from the sedimentation pond was also shown to be contributing to groundwater contamination. In addition, the survey also identified another potential source of groundwater contamination, the sludge dewatering pond. The results from the 20 meter coil spacing also indicated that the sludge dewatering pond may be providing a pathway from deeper leachate migration. A comparison of results between the November, 1984 and April 1985 surveys indicated a slight seasonal variation in the intensity of the plume, attributable to leachate discharge in the springs. Little migration of the plume was shown between the November, 1984 and April 1985 survey. Continued monitoring of ground conductivity along the permanently established survey lines will enable an evaluation of the effectiveness of planned remedial measures on improving groundwater quality downgradient of the site. (See also W87-02437) (Lantz-PTT)
W87-02455

COMMON PROBLEMS ENCOUNTERED WHEN EVALUATING CONTAMINANT MIGRATION IN BEDROCK: A SURVEY OF CASE HISTORIES IN NEW ENGLAND,
GHR Engineering Associates, Inc., New Bedford, MA.
W. R. Norman.
IN: The Second Annual Eastern Regional Ground Water Conference, July 16-18, 1985, Portland, Maine. 1985. p 384-415, 11 fig, 1 tab, 13 ref.

Descriptors: *Path of pollutants, *Bedrock, *Groundwater pollution, *Case studies, *New England, Rock properties, Performance evaluation, Geohydrology.

Based upon the case histories presented in this paper and a review of similar bedrock assessments by others of sites in New England, the following problems encountered, or errors made, during the bedrock evaluation were identified: (1) Complete failure to consider bedrock as a contaminant transport media; (2) Failure to accurately assess minor and major trends in bedrock structure; (3) Failure to use one or more confirmatory techniques to assess hydrologic conditions, bedrock structure and configuration; (4) Utilization of investigative techniques that are not suited or incompatible with bedrock conditions and contaminant character; and (5) Failure to consider Site-specific bedrock and contaminant characteristics prior to planning an assessment. Regardless of careful preliminary planning, problems arise and errors are often made during assessment of hydrogeologic conditions. If rectified during field activities or by subsequent study, errors in assessment and predictions can be minimized. Otherwise, results obtained will be unreliable and will only add to the uncertainties inherent in the assessment process. (See also W87-02437) (Lantz-PTT)
W87-02463

HAZARDOUS WASTE INVESTIGATIONS IN FRACTURED BEDROCK: A CASE STUDY,
NUS Corp., Bedford, MA.
For primary bibliographic entry see Field 5G.
W87-02464

IDENTIFICATION AND ASSESSMENT OF OVERBURDEN AND FRACTURED BEDROCK AQUIFERS AT SELECTED HAZARDOUS WASTE SITES IN NEW HAMPSHIRE,
M. S. Robinette, P. G. Regan, and J. M. Regan.
IN: The Second Annual Eastern Regional Ground Water Conference, July 16-18, 1985, Portland, Maine. 1985. p 426-434, 7 fig, 1 ref.

Descriptors: *Path of pollutants, *Bedrock, *Aquifers, *Hazardous wastes, *New Hampshire, *Groundwater pollution, Water pollution sources, Water sampling, Fate of pollutants, Monitoring,

Test wells, Hydraulic properties, Geophysics, Pump tests.

A technical approach for determining the severity and extent of groundwater contamination in the multiaquifer systems included the following study elements: historical site evaluations of past practices and available data; geologic and hydrogeologic field mapping; fracture fabric analysis of the bedrock; geophysical surveys including seismic refraction, electromagnetic, total field magnetics and electrical resistivity; overburden and bedrock monitoring well drilling; in situ hydraulic tests and pumping tests; surface water, groundwater and soils sampling and computer modeling. The two case studies illustrate the importance of utilizing fracture fabric analysis to locate monitoring wells within major fractures horizons which dominate contaminant transport in the bedrock aquifer. At both sites discussed, the fracture fabric analysis identified lineaments which were located in the field with seismic refraction and magnetometry surveys. Monitoring wells drilled into these horizons showed significant groundwater contamination while nearby wells, not penetrating the fracture, showed little or no contamination. Pumping tests confirmed the presence and extent of the fractures by documenting well interconnections. Water samples from wells penetrating the fractures versus outside the fracture system show contamination levels 10 to 1000 times less. (See also W87-02437) (Lantz-PTT)
W87-02465

GROUND WATER MONITORING AT A HAZARDOUS WASTE FACILITY LOCATED OVER FRACTURED VOLCANIC ROCK,
For primary bibliographic entry see Field 7B.
W87-02466

POTENTIAL IMPACTS OF ACIDIC PRECIPITATION ON A SOLE-SOURCE AQUIFER,
New York State Legislative Commission on Water Resources Needs of Long Island, Hauppauge.
G. Proios.
IN: The Second Annual Eastern Regional Ground Water Conference, July 16-18, 1985, Portland, Maine. 1985. p 451-463, 28 ref.

Descriptors: *Acid rain, *Aquifers, *Water pollution effects, *Path of Pollutants, *Groundwater pollution, *Environmental effects, Water pollution sources, Hydrogen ion concentration, Aluminum, Fate of pollutants, Wells, Sweden, New York, Magnesium, Soil properties.

Due to the ability of acid rain to leach various substances from soils, there is concern that these materials may migrate downward and contaminate groundwater supplies. The rate at which this may occur, depends upon the availability of buffering compounds, rate of precipitation and soil composition. In 1981, a study was published which analyzed the extent of aluminum contamination of groundwater in the New Jersey Pine Barrens. The study found that precipitation had an average pH of 4.0 and groundwater pH had an average of 4.6. This high acidity dissolved aluminum from the soils and was being detected in streams and groundwater samples at levels of up to 3 milligrams/L. Shallow groundwater wells have also been shown to be affected by acid precipitation. Studies on the contamination of shallow wells conducted in several Nordic countries, especially Sweden, where buffering compounds in the soil are generally lacking, were shown to be directly related to acid rain. Metals, such as aluminum and magnesium, can be mobilized by the acidic rainwater and thus carried downward into the aquifer. The concerns for loss of wildlife, destruction to buildings and monuments, public health effects, forest and agricultural damage, and drinking water contamination should place acid rain high on priority lists for remedial action. It has been estimated that acid rain causes as much as $5 billion annually in environmental damage, mostly in the northeastern United States and Canada. On Long Island, concern is with the possible impact of acid rain as it relates to the leaching of toxic metals from the soils, effects on plant and animal communities, the loss of nutrients from woodlands and agricultural areas, a reduction in crop yields (potatoes), and potential groundwater contamination especially in areas where there are very limited buffering compounds available. (See also W87-02437) (Lantz-PTT)
W87-02467

HAZARDOUS WASTE SITE INVESTIGATIONS: VINYL CHLORIDE CONTAMINATION OF GROUNDWATER,
Suffolk County Dept. of Health Services, Hauppauge, NY.
A. Andreoli.
IN: The Second Annual Eastern Regional Ground Water Conference, July 16-18, 1985, Portland, Maine. 1985. p 482-489, 2 fig.

Descriptors: *Hazardous wastes, *Vinyl chloride, *Groundwater pollution, Water pollution sources, Path of pollutants, New York, Tetrachloroethylene, Industrial wastes, Groundwater movement, Distribution patterns.

In September 1983, the Suffolk County Department of Health Services delineated a narrow plume of highly contaminated groundwater in a residential area of North Bay Shore, Suffolk County, New York. The plume, which contains concentrations of vinyl chloride as high as 2,800 ppb and tetrachloroethylene was traced back to a point immediately downgradient of a uniform rental/dry cleaning establishment. No vinyl chloride or tetrachloroethylene were found immediately upgradient of the facility, but were found at shallow depths just downgradient. Samples from the facility's cesspools indicated the presence both chemicals. In addition, an analysis of waste sludge from the facility taken at an earlier data contained 3.5% tetrachloroethylene and an unspecified concentration of vinyl chloride, indicating that vinyl chloride was being formed during the dry-cleaning process. The average linear velocity of groundwater in the region is calculated to be about 1.6 ft/day. Therefore, the 2/3 mile long plume represented discharges over a period of about seven years. (See also W87-02437) (Lantz-PTT)
W87-02469

POLLUTION POTENTIAL AND REAL ESTATE,
Snell Environmental Group, Inc., Lansing, MI.
For primary bibliographic entry see Field 5C.
W87-02502

PROGRESSIVE SITE EVALUATION,
O.H. Materials Co., Findlay, OH.
D. Winegardner, and J. Quince.
IN: Proceedings of the Fifth National Symposium and Exposition on Aquifer Restoration and Ground Water Monitoring, May 21-24, 1985, The Fawcett Center, Columbus, Ohio. 1985. p 69-74.

Descriptors: *On-site investigations, *Spills, *Project planning, *Groundwater pollution, Cost analysis, Fate of pollutants, Cleanup operations, Case studies, Management.

Investigations of spill situations, especially those involving groundwater contamination can result in panic and confusion. In an effort to save money, many inexperienced clients request a minimum fixed-fee investigation with a guarantee of results. This type of project forces the consultant to prepare a work plan (based on minimal background data) which has a rigid scope of work and yet is general enough to define the extent of the problem. On occasions, this arrangement functions very well. However, in a large number of cases, the complexity of subsurface conditions causes this approach to be less than satisfactory. In a few well known situations, the final study costs have been more than the total cleanup itself. The common idea shared between the case histories described in this paper is that a well-planned, progressive investigation or restoration project will result in a significant savings of time and effort. In economic terms, time-and-materials projects will often outperform fixed rate projects, if they are management properly. (See also W87-02497) (Lantz-PTT)
W87-02503

REMEDIAL ALTERNATIVES FOR SOURCE ABATEMENT: THE NECESSARY STEP,
O.H. Materials Co., Findlay, OH.
J. Hitchings, J. Quince, and M. Glaze.
IN: Proceedings of the Fifth National Symposium and Exposition on Aquifer Restoration and Ground Water Monitoring, May 21-24, 1985, The Fawcett Center, Columbus, Ohio. 1985. p 75-80.

Descriptors: *Remedies, *Water pollution sources, *Water pollution control, Groundwater pollution, Water quality control, Hazardous wastes, Spills, Cleanup operations, Cost analysis, Storage tanks.

It is well known that an unabated or an attenuated continuing source of contamination can add years, even tens of years, to the total duration of a remedial groundwater cleanup. The net result of such an impact is measured in dollars and slipped decimal points. Therefore, a comprehensive remedial plan must include provisions for dealing with the active source in the very early stages of project implementation. Sources of contamination range from indiscriminate spills and leaking tanks to disposal impoundments and uncontrolled hazardous waste sites. The active source must be identified, defined, and abated or attentuated if an effective groundwater remedial action is to be undertaken. (See also W87-02497) (Lantz-PTT)
W87-02504

GUIDELINES FOR MONITORING WELL INSTALLATION,
Wisconsin Dept. of Natural Resources, Madison.
For primary bibliographic entry see Field 7B.
W87-02505

CHANGES OF GROUND WATER QUALITY AROUND A WELL DURING ACID TREATMENT,
Krakow Technical Univ. (Poland). Faculty of Sanitary and Environmental Engineering.
W. Wojcik, and A. Wieczysty.
IN: Proceedings of the Fifth National Symposium and Exposition on Aquifer Restoration and Ground Water Monitoring, May 21-24, 1985, The Fawcett Center, Columbus, Ohio. 1985. p 116-131, 12 fig, 4 ref.

Descriptors: *Groundwater quality, *Acidity, *Chemical dissolution, Wells, Unconsolidated aquifers, *Groundwater pollution, Water pollution sources, Path of pollutants, Hydrochloric acid.

Chemical dissolution is one of the rehabilitation methods applied to the incrusted wells in acid treatment. In many cases however, the owners of wells and contractors are afraid of a possibility of aquifer pollution. The aim of the field experiments, has been to find out how far hydrochloric acid can migrate within an unconsolidated aquifer, and what changes it causes in the quality of groundwater. Received results indicate that the acid remains mainly in the space close to the well, where it reacts with clogging deposits. Twenty-four hours after the acidizing, no changes in groundwater quality were observed in holes 5.0 m distant from the well. The quality of water after pumping-tests returned to the same level as before the treatment. (See also W87-02497) (Author's abstract)
W87-02506

GROUND WATER QUALITY ANOMALIES ENCOUNTERED DURING WELL CONSTRUCTION, SAMPLING, AND ANALYSIS IN THE ENVIRONS OF A HAZARDOUS WASTE MANAGEMENT FACILITY,
Woodward-Clyde Consultants, Walnut Creek, CA.
D. Dunbar, H. Tuchfeld, R. Siegel, and R. Sterbentz.
IN: Proceedings of the Fifth National Symposium and Exposition on Aquifer Restoration and Ground Water Monitoring, May 21-24, 1985, The Fawcett Center, Columbus, Ohio. 1985. p 132-141, 1 fig, 3 tab, 1 ref.

Descriptors: *Groundwater quality, *Groundwater pollution, *Wells, *Construction, *Hazardous

wastes, Waste management, Water sampling, Water analysis, Hydrogen ion concentration, Tetrahydrofuran, Trihalomethane, Drilling fluids.

The occurrence of a number of groundwater quality anomalies during field investigations demonstrated the need for careful attention to specialized well construction, sampling and analysis procedures. The specific anomalies and their corresponding causes include: (1) elevated pH values due to poor well construction procedures; (2) the presence of tetrahydrofuran caused by the use of glue at casing joints; (3) the temporary occurrence of trihalomethanes produced during the breakdown of synthetic drilling fluid; and (4) cross-contamination of groundwater samples due to incomplete equipment decontamination procedures. (See also W87-02497) (Lantz-PTT)
W87-02507

FACTORS REQUIRING RESOLUTION IN INSTALLING VADOSE ZONE MONITORING SYSTEMS,
Woodward-Clyde Consultants, Santa Ana, CA.
For primary bibliographic entry see Field 7B.
W87-02510

GROUND WATER FLOW IN LIMESTONE TERRANES: STRATEGY RATIONALE AND PROCEDURE FOR RELIABLE, EFFICIENT MONITORING OF GROUND WATER QUALITY IN KARST AREAS,
National Park Service, Mammoth Cave, KY.
For primary bibliographic entry see Field 2F.
W87-02511

COMPARISON OF SAMPLING MECHANISMS AVAILABLE FOR SMALL-DIAMETER GROUND WATER MONITORING WELLS,
IEP, Inc., Worthington, OH.
For primary bibliographic entry see Field 7B.
W87-02512

USE OF CONDUCTIVITY PROFILES IN GROUND WATER QUALITY INTERPRETATION,
Jordan (Edward C.) Co., Inc., Portland, ME.
For primary bibliographic entry see Field 5G.
W87-02514

EVALUATING CADMIUM SOLUBILITY IN A LANDFILL WITH MINERAL STABILITY ANALYSES,
Goldberg-Zoino and Associates, Inc., Newton Upper Falls, MA.
W. G. Williams, and K. Fogarty.
IN: Proceedings of the Fifth National Symposium and Exposition on Aquifer Restoration and Ground Water Monitoring, May 21-24, 1985, The Fawcett Center, Columbus, Ohio. 1985. p 310-325, 9 tab, 5 ref.

Descriptors: *Cadmium, *Landfills, *Mineral stability analyses, *Path of pollutants, Geochemistry, Hydrogen ion concentration, Chemical precipitation, Carbonates, Limestone, Ferrous sulfide, Sulfides, Halides, Sodium, Chemical reactions, Computer programs.

If the pH of the landfill material is stabilized with limestone, above pH 5 cadmium precipitates as the carbonate when leached by water containing low levels of dissolved solids. However, the cadmium concentration is 1.6 mg/L, at the low end of the pH range so this treatment may not be effective. Changing the treatment to ferrous sulfide produces a stable cadmium sulfide precipitate which is highly insoluble over the pH range of 4 to 10. Cadmium complexes strongly with halides which suggests leachate containing high concentrations of chloride could contain higher concentrations of soluble cadmium. The limestone and ferrous sulfide treatments were investigated for this additional factor by employing an aqueous medium containing sodium (2700 mg/L0, chloride (4000 mg/L), sulfate (580 mg/L), and carbonate (150 mg/L). When limestone treatment is employed, cadmium is precipitated as a carbonate above pH 6 and as a hydroxide above pH 10 but cadmium complexes maintain soluble cadmium above the 1 mg/L Resource Conservation and Recovery Act standard. With ferrous sulfide treatment, the great insolubility of cadmium sulfide is sufficient to maintain soluble cadmium at very low levels although the primary species is the monochloride complex. (See also W87-02497) (Lantz-PTT)
W87-02515

DEVELOPMENT OF A GROUND WATER MODEL UTILIZING THE INSTALLATION AND TESTING OF A VARIABLE DEPTH CLUSTER MONITORING WELL NETWORK,
Hess (R.K.R.) Associates, Stroudsburg, PA.
For primary bibliographic entry see Field 7A.
W87-02518

COMBINED EM RESISTIVITY AND FLUOROMETRY WITH DIRECT GROUNDWATER FLOW MEASUREMENT FOR LOCAL CHARACTERIZATION OF LANDFILL PLUMES,
K-V Associates, Inc., Falmouth, MA.
W. B. Kerfoot, and S. W. Rumba.
IN: Proceedings of the Fifth National Symposium and Exposition on Aquifer Restoration and Ground Water Monitoring, May 21-24, 1985, The Fawcett Center, Columbus, Ohio. 1985. p 372-387, 6 fig, 12 ref.

Descriptors: *Electromagnetic waves, *Fluorometry, *Groundwater movement, *Landfills, *Path of pollutants, Boreholes, Solid wastes, Plumes, Groundwater pollution, Flow rate, Wells, Flowmeters, Flow measurement.

Electromagnetic soundings and exploratory boreholes were performed surrounding a municipal landfill to identify the location of potential contaminant plumes. Two overlapping source regions were identified, one eminating from solid waste fill placed in a northeast-oriented kettle trough and the other from the region of the septage disposal pits. Although some filling has inadvertently occurred on an adjacent property, leachate originating from both sources could be readily identified. The study showed that: (1) The plumes appear bi-lobed and progressing in both a north-north-easterly and northeasterly direction, with extensions underlying existing commercial property; (2) The rate of movement of the lobe is slow, from 0.1 to 0.3 ft/day based upon direct groundwater flow measurements; (3) No movement towards the municipal well field was observed. Contamination was not found in any water samples removed from the boreholes, wells, or samplers bordering the municipal water supply region; and (4) The use of direct flowmeter readings with electromagnetic resistivity provides a rapid means of characterization of plume position, rate, and direction across complex glacial till regions. (See also W87-02497) (Lantz-PTT)
W87-02519

MITIGATION OF HYDROCARBON CONTAMINATION IN WATER SUPPLY AQUIFERS VIA MULTI RECOVERY WELL FOR HYDROLOGIC CONTROL,
Groundwater Technology, Inc., Concord, CA.
For primary bibliographic entry see Field 5G.
W87-02523

SUBSURFACE HYDROCARBON VAPORS: LOW LEVEL SAMPLING AND ANALYTICAL TECHNIQUES APPLICABLE TO THEIR IDENTIFICATION/MITIGATION,
Groundwater Technology, Inc., Chadds Ford, PA.
S. Ames, J. H. Mulry, M. D. Webb, and P. Yaniga.
IN: Proceedings of the Fifth National Symposium and Exposition on Aquifer Restoration and Ground Water Monitoring, May 21-24, 1985, The Fawcett Center, Columbus, Ohio. 1985. p 476-484, 2 fig, 2 tab, 11 ref.

Descriptors: *Hydrocarbons, *Vapors, *Groundwater pollution, *Sampling, *Subsurface waters, *Path of pollutants, Benzene, Areal distribution, Plumes, Volatile organics, Environmental effects, Gas chromatography, Mass spectrometry, Chemical analysis.

Historic address to the subsurface loss of hydrocarbons initially focused upon free product recovery, and occasionally symptomatic explosive vapor concentrations. During the past 15 years the saturated soil and dissolved phases have received increasing attention. Most recently, health and regulatory agencies have expressed concern with an additional resultant, that of low level benzene concentrations in ambient and indoor air. This new concern presages significant health, legal and financial implications for the business, technical and regulatory community. One of the most significant tasks emerging as an integral aspect of comprehensive remedial action programs for subsurface hydrocarbon loss is that of definition of the areal extent of the subsurface vapor plume. The major decisions facing the investigator seeking to define the potential impacts of subsurface vapors include interpretation of the significance of indoor volatic organic compound measurements, selection of sampling and analytical techniques. Definition of the extent of the subsurface plume is critical to the process of assessing impacts, particularly for structures on the periphery of the spill. Monitoring points installed permanently, below grade appear to provide the best means for collection of data. Of current available methods, Tenax GC/MS is the best method for analysis of subsurface samples. (See also W87-02497) (Lantz-PTT)
W87-02526

GROUND WATER MANAGEMENT PLAN FOR PROTECTION OF A SHALLOW AQUIFER AT THE NAVAL WEAPONS CENTER, CHINA LAKE, CALIFORNIA,
Montgomery (James M.), Inc., Pasadena, CA.
For primary bibliographic entry see Field 5G.
W87-02537

PROTECTION OF A 700-GPM MUNICIPAL WELL FIELD WITH A 10-GPM BARRIER WELL,
Camp, Dresser and McKee, Inc., Boston, MA.
J. C. Johnson, B. H. Kolb, and P. J. Riordan.
IN: Proceedings of the Fifth National Symposium and Exposition on Aquifer Restoration and Ground Water Monitoring, May 21-24, 1985, The Fawcett Center, Columbus, Ohio. 1985. p 656-667, 6 fig, 1 tab.

Descriptors: *Municipal wells, *Groundwater pollution, *Water pollution treatment, *Barriers, *Wells, Massachusetts, Dichloroethylene, Waste disposal, Path of pollutants, Pumping wells, Model studies, Bedrock, Plumes Boreholes.

A municipal well field in Massachusetts was found to be contaminated with 1,1-dochloroethylene that originated from past waste disposal at a nearby chemical production facility. The waste disposal sites and the municipal wells were in a glacial outwash aquifer, and initial studies assumed that contamination traveled in a direct path through the aquifer sands from the sources to the wells. Interception of such a plume would have required large-capacity pumping wells. Use of a unique three-dimensional numerical model for groundwater flow and contaminant transport, showed that the assumed path of contamination could not have resulted in the levels of contamination found in the municipal wells. Model calibration was most successful with transport of a small flow of concentrated contamination through a thin fractured zone at the top of the bedrock and below a relatively impervious till/silt layer. A remedy was then simulated in which a small pumping well would extract and treat concentrated plume from the rock. The simulation showed that very rapid cleansing could be achieved with this relatively inexpensive remedy. After a field boring/well installation program confirmed the hypothesized properties of the upper rock zone, the bedrock pumping well was installed. Data from the first year of operation show that the system is performing successfully. (See also W87-02497) (Author's abstract)
W87-02538

Group 5B—Sources Of Pollution

GROUND WATER CONTAMINATION FROM UNDERGROUND SOLVENT STORAGE TANKS, SANTA CLARA, CALIFORNIA,
Cooper Engineers, Inc., Richmond, CA.
D. F. Oliveira, and N. Sitar.
IN: Proceedings of the Fifth National Symposium and Exposition on Aquifer Restoration and Ground Water Monitoring, May 21-24, 1985, The Fawcett Center, Columbus, Ohio. 1985. p 691-708, 4 fig, 11 ref.

Descriptors: *Groundwater pollution, *Underground storage, *Storage tanks, *Santa Clara, *California, Organic compounds, Alluvial aquifers, Groundwater movement, Toluene, Xylene, Methyl cyclohexane, Ethyl benzene, Solvents, Groundwater movement, Clay, Silt.

To date, over 100 cases of underground tank leaks and spills involving organic chemicals have been identified in Santa Clara Valley. The Santa Clara Valley is a structural basin filled by water-bearing unconsolidated alluvial fill. Groundwater derived from the alluvial aquifers forms a significant proportion of the domestic and municipal water supply. At present, the most severe contamination seems to be limited to the uppermost water-bearing units. Extensive effort is underway to contain the contamination and to clean up the spills in order to protect the deeper water-bearing units, which are used for municipal water supply. This paper describes groundwater contamination by industrial solvents, primarily toluene, xylene, methyl cyclohexane, and ethyl benzene, which leaked from underground storage tanks at a paint manufacturing facility in Santa Clara Valley. Investigation at the site showed that solvents lighter than water moved vertically downward through an aquitard of silty clay contaminating the shallow saturated zone to a depth of 44 feet. The rate at which the contaminants appear to have moved indicates that the in situ hydraulic conductivity of the native silty clay is at least an order of magnitude greater than determined from conventional laboratory tests. In addition, contaminants did not appear to be significantly retarded by interaction with the natural soils. (See also W87-02497) (Author's abstract)
W87-02540

EFFECTIVENESS OF HIGHWAY DRAINAGE SYSTEMS IN PREVENTING SALT CONTAMINATION OF GROUND WATER,
Massachusetts Dept. of Public Works, Wellesley Hills. Research and Materials Section.
For primary bibliographic entry see Field 4C.
W87-02541

POLLUTION CONTROL AND CONSERVATION.
For primary bibliographic entry see Field 5C.
W87-02553

BIOSPHERE, LANDSCAPE AND NATURAL RESOURCES,
University of Agriculture, Godollo (Hungary). Dept. of Botany and Plant Physiology.
M. Kovacs.
IN: Pollution Control and Conservation, Ellis Horwood Ltd., Chichester, England, 1985. p 24-36, 6 fig, 15 ref.

Descriptors: *Biosphere, *Natural resources, *Ecological effects, Path of pollutants, Water pollution sources, Precipitation, Degradation.

The concept of the biosphere, and its interrelated ecosystems are presented in this chapter, with emphasis being placed on the accumulation and migration of elements in the biosphere and man's role in the 'landscape' and natural resources. Elements accumulate and migrate in the biosphere from geochemical sources, precipitation, decomposition, and man's pollutants, and then migrate via animals, seeds, spores, etc. Industrial communities play a major role in this activity. The natural landscape (plants, soils, water) is greatly affected by this activity, but the stress pollutants force onto the environment, force changes through time, to better deal with pollutants. (See also W87-02553) (Lantz-PTT)
W87-02554

WATER POLLUTION,
For primary bibliographic entry see Field 5C.
W87-02556

SOIL DESTRUCTION AND SOIL POLLUTION,
P. Stefanovits.
IN: Pollution Control and Conservation, Ellis Horwood Ltd., Chichester, England, 1985. p 204-249, 15 fig, 6 tab, 72 ref.

Descriptors: *Soil contamination, *Soil conservation, Soil fertility, Agriculture, Irrigation effects, Cultivation, Soil chemistry.

The role of soil in the environment can be divided into two parts. First, it forms part of the natural and artificial environment and by joining the spheres of air and water (atmosphere and hydrosphere) it is one of the ecosystem constituents along with the community of living organisms. Second, it is merely a physical receptor of matter and energy flows reaching the Earth's surface, transforming and partly storing them. Soil differs both from air and water in its functioning as it is localized and is of solid state. The danger that pollutants will accumulate and will have a permanent effect is especially acute in the case of soil. While, by air and water circulation, the dilution and purification of these two factors is rendered possible, in case of soil, these processes cannot reduce the danger of damage. By its fertility, soil, an important component of the habitat, contributes not only to the existence of the vegetation and of the fauna living on it but also to the welfare of humanity. The decrease in soil fertility is, therefore, an important indicator of environmental pollution. The aim of agricultural production is to maintain and increase soil fertility. However, intensive cultivation of crops, mechanization and the application of various chemicals carried out to achieve this aim, also works of irrigation and drainage may lead to the reduction of soil fertility. Due to inadvisable measures taken towards eliminating certain unfavorable characteristics, these may result in the appearance of other even more harmful factors. (See also W87-02553) (Lantz-PTT)
W87-02557

SALTY COLORADO,
John Muir Inst. for Environmental Studies, Inc., Napa, CA.
T. O. Miller, G. D. Weatherford, and J. E. Thorson.
The Conservation Foundation, Washington, DC. 20037, 1986. 102 p.

Descriptors: *Water pollution sources, *Salinity, *Colorado River, *Water quality control, Load distribution, Concentration, Evaporation, Transpiration, Leaching, Cost analysis, Legislation.

On its 1,400-mile journey from the Rocky Mountains to the Gulf of California, the Colorado River annually picks up some 9 million tons of salt. Although much of this comes from natural sources, a century of agricultural, municipal, and industrial development in the Colorado River basin has made the problem worse. The salinity problem results from a combination of two processes: salt loading, or the addition of soluble salts to the river, and salt concentration, caused by a reduction in the volume of river water as a result of evaporation, transpiration, or upper basin withdrawals. Almost one-half of the Colorado's salt loading is estimated to come from interaction of the river with the basin's naturally saline soil and rocks. The 3 million acres of irrigated farmland in the region add more soluble minerals to the river as irrigation water leaches minerals from cultivated soils. More than 12 million people and 1 million acres of irrigated farmland - mainly in the lower basin states and Mexico - suffer reduced quality of Colorado River water due to salinity. The damages are diverse and difficult to quantify: degraded usefulness of Colorado River water for domestic, municipal, and industrial uses; decreased crop yields and salt buildup in soils; and strains on interstate and international relations. The Bureau of Reclamation estimates that salinity caused $91 million in total damages in 1983 and predicts a $267 million annual loss by 2010. Prompted by complaints from Mexico in the 1960s, Congress passed the Colorado River Basin Salinity Control Act in 1974 to improve the quality of the river's water and uphold prior agreements with Mexico. This bill established a salinity control program that would cost up to $900 million over the next 10 to 15 years if all projects under study were implemented. (Lantz-PTT)
W87-02561

5C. Effects Of Pollution

SHIFTS IN THE INTRACELLULAR ATP POOLS OF IMMOBILISED NOSTOC CELLS (CYANOBACTERIA) INDUCED BY WATER STRESS,
Florida State Univ., Tallahassee. Dept. of Biological Science.
For primary bibliographic entry see Field 2H.
W87-01771

BIOTRANSFORMATIONS OF CHLOROGUAIACOLS, CHLOROCATECHOLS, AND CHLOROVERATROLES IN SEDIMENTS,
Swedish Environmental Research Inst., Stockholm.
M. Remberger, A.-S. Allard, and A. H. Neilson.
Applied and Environmental Microbiology AEMIDF, Vol. 51, No. 3, p 552-558, March 1986. 5 fig, 2 tab, 34 ref.

Descriptors: *Path of pollutants, *Fate of pollutants, *Chloroguaiacols, *Chlorocatechols, *Chloroveratroles, *Sediments, *Bleaching wastes, *Guaiacol cycle, Freshwater, Brackish water, Metabolism, Anaerobic conditions.

The occurrence of trichloro- and tetrachloroguaiacols, -catechols, and -veratroles and their transformation was studied in freshwater and brackish water sediments putatively exposed to chemical pulp bleachery discharge. The samples contained both chloroguaiacols and chlorocatechols, of which >90% could not be removed by simple extraction. The bound concentrations varied, ranging from 55 microgram (ug)/kg of organic C for 3,4,5-trichloroguaiacol to 8,240 ug/kg organic C for tetrachlorocatechol. Chlorinated substrates added to the aqueous phase were bound rapidly to the sediment with K sub p values between 1.3 and 2.8 ml/kg organic C for the chloroguaiacols and chloroveratroles and 22-36 ml/kg organic C for the chlorocatechols. Sediment samples incubated aerobically brought about O-methylation of 4,5,6-trichloroguaiacol to 3,4,5-trichloroveratrole in a yield of about 25%. Under anaerobic conditions, however, de-O-methylation of both the chloroguaiacols and chloroveratroles took place, with synthesis of the corresponding chlorocatechols. In separate experiments, the chlorocatechols were not completely stable under anaerobic conditions, but their ultimate fate has not been resolved. Sediment that had been autoclaved twice at 121 C for 20 min was unable to bring about any of these transformations, leading to the conclusion that they were mediated by biological processes. A hypothetical guaiacol cycle is proposed to account for the present observations. (Author's abstract)
W87-01784

ETHYLENE DIBROMIDE MINERALIZATION IN SOILS UNDER AEROBIC CONDITIONS,
Connecticut Agricultural Experiment Station, New Haven. Dept. of Soil and Water.
For primary bibliographic entry see Field 5B.
W87-01785

INFLUENCE OF CYANOBACTERIAL HYPERSCUM ON HETEROTROPHIC ACTIVITY OF PLANKTONIC BACTERIA IN A HYPERTROPHIC LAKE,
National Inst. for Water Research, Pretoria (South Africa).
R. D. Robarts, and T. Zohary.

Applied and Environmental Microbiology AEMIDF, Vol. 51, No. 3, p 609-613, March 1986. 3 fig, 2 tab, 22 ref.

Descriptors: *Scum, *Eutrophic lakes, *Limnology, *Heterotrophic bacteria, *Plankton, *Cyanophyta, *Floating mat, *Hyperscum, *Dissolved organic carbon, Bacterial growth, Metabolism, Hartbeesport Dam, South Africa.

The response of the planktonic heterotrophic bacterial community to the buildup and breakdown of a semipermanent, crusted, floating cyanobacterial mat, or hyperscum, which covered 1 to 2 hectare was studied in the hypertrophic Hartbeespoort Dam, South Africa. The initial response of bacteria in the main basin to the release of dissolved organic carbon (DOC) from the hyperscum 1 km away was an increase in activity per cell from 35 x 10 to the minus 12th power to 153 x 10 to the minus 12th power microgram (ug) of C/cell per hr for total cell counts, whereas activity per cell for metabolically active cells increased from 19 x 10 to the minus 11th power to 85 x 10 to the minus 11th power ug of C/cell per hr. No major population growth occurred at this stage. Later, with the continuous supply of DOC from the hyperscum, total bacterial numbers increased from 6,600,000 to 20,000,000 cells/ml, while the activity per cell declined. Metabolically active bacteria followed the same trend. Shorter-term DOC increases caused only increases in bacterial activity per cell. The present data demonstrate a little-documented mechanism by which aquatic bacteria respond to increased DOC concentration that may be universal in aquatic systems. (Author's abstract)
W87-01786

RESPONSES OF ISONYCHIA BICOLOR TO ALKALINE PH: AN EVALUATION OF SURVIVAL, OXYGEN CONSUMPTION, AND CHLORIDE CELL ULTRASTRUCTURE,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Biology.
G. T. Peters, D. S. Cherry, and J. Cairns, Jr.
Canadian Journal of Fisheries and Aquatic Sciences CJFSBX, Vol. 42, No. 6, p 1088-1095, June 1985. 2 fig, 2 tab, 21 ref.

Descriptors: *Mayfly, *Alkalinity, *Toxicity, *Bioassay, *Hydrogen ion concentration, Artificial watercourses, Respiration, Transmission electron microscopy, Chloride cells, Ultrastructure, Intermittent exposures, Continuous exposures, Animal pathology, Recovery, Oxygen consumption.

The toxicity of alkaline pH to the mayfly, Isonychia bicolor, was evaluated in field and laboratory artificial stream bioassays, respiration analyses, and transmission electron microscope studies of chloride cell ultrastructure. In continuous-exposure, 96-hr bioassays, field and laboratory LC50 values ranged from pH 9.54 to 10.37, respectively. While intermittent pH bioassays with 8- or 4-hr exposures per day failed to reduce alkaline pH toxicity, 1-hr intermittent exposures were less toxic than continuous exposures. Acute (4-hr) exposures to lethal (pH 11.0) and sublethal (pH 10.0) levels caused reductions in oxygen consumption relative to that at pH 8.0, but oxygen consumption at pH 11.0 was greater than at pH 10.0. Coniform chloride cells continuously exposed to pH 11.0 for 96 hr accumulated fluid near the porous plate, and these fluid accumulations displace cytoplasm from the apical region of the cell complexes. Chloride cells exposed to pH 11.0 for 1 hr/day for 96 hr appeared similar to those continously exposed at the same pH, indicating that the damaging effects of 1-hr exposures exceeded rehabilitory effects of daily 23-hr recovery periods. Structural recovery (95%) occurred within 8 days following the cessation of intermittent exposure to pH 11.0. (Author's abstract)
W87-01789

RELATIONSHIP OF CRAYFISH (ORCONECTES VIRILIS) GROWTH TO POPULATION ABUNDANCE AND SYSTEM PRODUCTIVITY IN SMALL OLIGOTROPHIC LAKES IN THE EXPERIMENTAL LAKES AREA, NORTHWESTERN ONTARIO,
Department of Fisheries and Oceans, Winnipeg (Manitoba). Freshwater Inst.
For primary bibliographic entry see Field 2H.
W87-01790

CHEMISTRY OF LAKE HOVVATN, NORWAY, FOLLOWING LIMING AND REACIDIFICATION,
Norsk Inst. for Vannforskning, Oslo.
For primary bibliographic entry see Field 5B.
W87-01791

INFLUENCE OF FISH-ZOOPLANKTON-PHYTOPLANKTON INTERACTIONS ON THE RESULTS OF SELENIUM TOXICITY EXPERIMENTS WITHIN LARGE ENCLOSURES,
Department of Fisheries and Oceans, Winnipeg (Manitoba). Freshwater Inst.
A. Salki, M. Turner, K. Patalas, J. Rudd, and D. Findlay.
Canadian Journal of Fisheries and Aquatic Sciences CJFSBX, Vol. 42, No. 6, p 1132-1143, June 1985. 8 fig, 3 tab, 58 ref.

Descriptors: *Fish, *Zooplankton, *Phytoplankton, *Interactions, *Selenium *Toxicity, *Enclosures, *Mercury pollution, *Community development, Clay Lake, Ontario, Predation, Crustacea.

The response of zooplankton to sodium selenite at concentrations of 1, 20, and 100 microgram (ug) Se/liter was studied using 100-cu m enclosures in Hg-contaminated Clay Lake, Ontario. Crustacean community development in treated enclosures exhibited no obvious acute or chronic effects from the range of Se concentrations applied. Seasonal changes in zooplankton composition, abundance, and reproduction were similar among controls and the 1 and 10 ug Se/l enclosures. Differences in species dynamics observed in the 100 ug Se/l enclosure and in a sediment control enclosure were attributable to biotic interactions rather than Se. Predation appeared to be the dominant factor governing zooplankton community structure in all enclosures. Differences in the number of planktivorous fish among enclosures led to variations in the abundance of predatory Leptodora kindtii, which in turn affected abundances of Bosmina longirostris. (Author's abstract)
W87-01792

ORGANIC NITROGEN COMPOUNDS IN ATMOSPHERIC PRECIPITATION: THEIR CHEMISTRY AND AVAILABILITY TO PHYTOPLANKTON,
Department of Scientific and Industrial Research, Taupo (New Zealand). Div. of Marine and Freshwater Sciences.
For primary bibliographic entry see Field 5B.
W87-01793

PHYTOPLANKTON RESPONSE TO FRESHWATER RUNOFF: THE DIVERSION OF THE EASTMAIN RIVER, JAMES BAY,
McGill Univ., Montreal (Quebec). Inst. of Oceanography.
R. G. Ingram, L. Legendre, Y. Simard, and S. Lepage.
Canadian Journal of Fisheries and Aquatic Sciences CJFSBX, Vol. 42, No. 6, p 1216-1221, June 1985. 6 fig, 13 ref.

Descriptors: *Phytoplankton, *Freshwater, *Salinity, *Nutrients, *Hydrodynamics, *James Bay, *Diversion, Hydroelectric power, Eutrophication, Canada, Eastmain River.

Phytoplankton, nutrients, and hydrodynamic conditions were regularly sampled in the estuary of the Eastmain River (Quebec) and offshore in James Bay, before and after the diversion of the river for hydroelectric development on 19 July 1980. In the estuary mean flow decreased by over 90%, and the semidiurnal tidal amplitude increased significantly over a 5-day period. The most dramatic event was a major phytoplankton bloom in the river mouth, during a 10-day period of higher water column stability in late August; the cells then remained and bloomed in the thin photic layer. The present results stress the role of hydrodynamics (as determined here by freshwater runoff) in the timing of phytoplankton blooms. (Author's abstract)
W87-01794

USE OF A BACTERIAL BIOLUMINESCENCE ASSAY TO ASSESS TOXICITY OF CONTAMINATED MARINE SEDIMENTS,
National Marine Fisheries Service, Seattle, WA. Northwest and Alaska Fisheries Center.
For primary bibliographic entry see Field 5A.
W87-01795

INFLUENCE OF THE INSECTICIDE DIFLUBENZURON (DIMILIN) ON THE GROWTH OF MARINE DIATOMS AND A HARPACTICOID COPEPOD IN CULTURE,
Department of Fisheries and Oceans, Vancouver (British Columbia). West Vancouver Lab.
N. J. Antia, P. J. Harrison, D. S. Sullivan, and T. Bisalputra.
Canadian Journal of Fisheries and Aquatic Sciences CJFSBX, Vol. 42, No. 7, p 1272-1277, July 1985. 3 fig, 3 tab, 33 ref.

Descriptors: *Diflubenzuron, *Dimilin, *Growth, *Photosynthesis, *Diatoms, *Copepods, *Chitin, *Cuticles, *Larvicides, *Insects, *Crustaceans, Ecdysis, Metabolism, Juvenile development, Plant pathology, Plant physiology.

Diflubenzuron (Dimilin), in the concentration range 0.1-5,000 microgram/liter (ug/l), was tested for possible injurious efffects on the growth and photosynthesis of three chitin-producing diatoms (Thalassiosira weissflogii, T nordenskioldii, Cyclotella cryptica) and one nonchitinaceous diatom (Skeletonema costatum). For comparison, the effects of the pesticide also were examined on the juvenile development and adult survival of the harpacticoid copepod Tigriopus californicus. Whereas the development of the copepod was hindered at concentrations of the order of 1-10 ug/l, the diatoms were barely affected by Dimilin even at the highest concentration tested. The authors conclude that Dimilin acts specifically on insects and crustaceans as a larvicide by interfering with chitin deposition into cuticles during juvenile development through ecdysis. The lack of effect on the chitin-producing diatoms suggests that the insecticide may not inhibit chitin biosynthesis per se as was previously believed, but that it presumably deregulates one or more of the larval postsynthetic processes responsible for integration of chitin into cuticles. (Author's abstract)
W87-01797

NUTRIENT DYNAMICS IN A LITTORAL SEDIMENT COLONIZED BY THE SUBMERSED MACROPHYTE MYRIOPHYLLUM SPICATUM,
Institut National de la Recherche Scientifique, Sainte-Foy (Quebec).
For primary bibliographic entry see Field 2H.
W87-01799

ION FLUX RATES, ACID-BASE STATUS, AND BLOOD GASES IN RAINBOW TROUT, SALMO GAIRDNERI, EXPOSED TO TOXIC ZINC IN NATURAL SOFT WATER,
Ontario Ministry of Natural Resources, Whitney. Harkness Lab. of Fisheries Research.
D. J. Spry, and C. M. Wood.
Canadian Journal of Fisheries and Aquatic Sciences CJFSBX, Vol. 42, No. 8, p 1332-1341, August 1985. 6 fig, 3 tab, 53 ref.

Descriptors: *Rainbow trout, *Zinc, *Toxicity, *Water softening, *Hydrogen ion concentration, *Acid-base status, *Gills, Sodium ions, Chloride ions, Acidosis, Potassium ions, Kidney function, Isotope studies, Excretion, Ammonia.

Exposure to 0.8 mg Zn2+/liter in natural soft water for up to 72 hr was toxic to rainbow trout, causing an acid-base disturbance and net branchial ion losses. Mean arterial pH fell from 7.78 to 7.58. Both Pa sub C02 and lactate rose, indicating a

mixed respiratory and metabolic acidosis, despite maintenance of high Pa sub 02. Net branchial uptake of Na+ and Cl- became a net loss immediately following exposure to Zn(2+), and this continued during 60 hr of exposure. Net K+ loss was exacerbated, and net Ca2+ uptake was abolished. Unidirectional flux measurements with 22Na+ and 36Cl- indicated an increased efflux immediately following Zn exposure. Both influx and efflux of Na+ and Cl- were stimulated after 48-60 hr in Zn2+. Both net branchial ammonia excretion and net branchial uptake of acidic equivalents from the water (= base loss) were stimulated greatly, the latter contributing to metabolic acidosis. Kidney function, as measured by urine flow rate and excretion of ammonia, acidic equivalents, Na+, Cl-, K+, and Za2+, was relatively insensitive to the effects of Zn. The only renal component affected was Ca2+ excretion, which decreased during a single flux period, possibly in response to the reduced entry Ca2+ at the gill. The authors conclude that toxic concentrations of Zn are capable of altering gill function to cause ionoregulatory and acid-base disturbances without disturbance of Pa sub 02. (Author's abstract)
W87-01800

HISTORICAL RELATIONSHIPS BETWEEN PHOSPORUS LOADING AND BIOGENIC SILICA ACCUMULATION IN BAY OF QUINTE SEDIMENTS,
Michigan Univ., Ann Arbor. Great Lakes Research Div.
C. L. Schelske, D. J. Conley, and W. F. Warwick.
Canadian Journal of Fisheries and Aquatic Sciences CJFSBX, Vol. 42, No. 8, p 1401-1409, August 1985. 5 fig, 1 tab, 22 ref. EPA Grant R810396, NSF Grant OCE-8216588.

Descriptors: *Lake Ontario, *Bay of Quinte, *Sediments, *Biogenic silica, *Phosphorus, *Diatoms, History, Urbanization, Erosion, Forest clearance, Wastewater pollution.

Sediments from Warwick's 1972 Glenora-B core from the Bay of Quinte, Lake Ontario, were analyzed to compare the historical relationship between the accumulation of biogenic silica (BSi) and total phosphorus (TP). The similarities in patterns provide evidence that increased P inputs caused increased diatom production and BSi accumulation. BSi acumulation increased soon after initial European settlement by the French Sulpicians in 1669 and reached maximum levels during the early 1850s when forest clearance and erosion of the deforested drainage basin increased sediment accumulation rates 110-fold compared with rates before 1669. Maximum rates of BSi and TP accumulation increased 170-fold and 150-fold, respectively, during the same period. Ratios of BSi:TP were about 6-fold greater in the sediments deposited after 1888 than in those deposited prior to 1669, indicating that the proportion of available P in TP inputs increased with increased disposal of domestic sewage into the bay as populations shifted to urban centers. Increases in BSi accumulation above the Ambrosia horizon (dated at 1852) indicate that sediments can be a significant sink for BSi. Although the onset of Si depletion cannot be confirmed with data from this core, there is clear evidence that BSi accumulation increased as the result of increased P inputs. (Author's abstract)
W87-01803

PATTERNS OF EPIPELIC ALGAL ABUNDANCE WITH DEPTH, TROPHIC STATUS, AND ACIDITY IN POORLY BUFFERED NEW HAMPSHIRE LAKES,
Louisville Univ., KY. Dept. of Biology.
For primary bibliographic entry see Field 2H.
W87-01806

LABORATORY STUDY OF THE EFFECTS OF ALUMINUM AND PH ON AMPHIBIAN EGGS AND TADPOLES,
Biota Environmental Contractors, Dorset (Ontario).
K. L. Clark, and B. D. LaZerte.
Canadian Journal of Fisheries and Aquatic Sciences CJFSBX, Vol. 42, No. 9, p 1544-1551, September 1985. 1 fig, 2 tab, 30 ref, append.

Descriptors: *Aluminum, *Acid rain, *Hydrogen ion concentration, *Eggs, *Tadpoles, *Toxicity, *American toad, *Wood frog, *Bioassay, Ponds, Streams, Ontario, Canada, Hatching success, Aluminum speciation, Freshwater, Acidification.

Bufo americanus and Rana sylvatica eggs and tadpoles were exposed in laboratory bioassays to a range of pH and Al concentrations commonly encountered in ponds and streams of central Ontario. Hatching success of both species was reduced at pH 4.14. The addition of 10 microgram/liter (ug/l) iorganic monomeric Al (IMAl) at pH < 4.35 further reduced hatching success of B americanus, whereas R sylvatica was slightly less sensitive with hatching success being reduced by addition of 20 ug/l IMAl at pH 4.14. Increasing Al concentrations at pH 4.14 appeared to have no further effect, except at the highest level used (200 ug/l). IMAl concentrations that were toxic at pH 4.35 or 4.14 had no effect at pH 4.75 or 5.75. Toxicity was not dependent on Al speciation, because similar levels of Al(3+) and Al(OH)x complexes that were toxic at pH 4.14 were not toxic at pH 4.75. Also, Al(F)x complexes were as toxic as Al(3+). Egg mortality due to hydrogen ion stress was correlated with delay in time of hatch and a reduction in egg size, but there was no consistent pattern with respect to Al stress. B americanus and R sylvatica tadpoles were not sensitive to up to 200 ug/l IMAl and pH as low as 4.14. (Author's abstract)
W87-01808

INTERACTIVE EFFECTS OF CADMIUM, POLYCHLORINATED BIPHENYLS, AND FUEL OIL ON EXPERIMENTALLY EXPOSED ENGLISH SOLE (PAROPHRYS VETULUS),
National Marine Fisheries Service, Seattle, WA. Northwest and Alaska Fisheries Center.
L. Rhodes, E. Casillas, B. McKnight, W. Gronlund, and M. Myers.
Canadian Journal of Fisheries and Aquatic Sciences CJFSBX, Vol. 42, No. 12, p 1870-1880, December 1985. 8 fig, 4 tab, 49 ref. EPA Interagency Agreement EPA79-D-X0514.

Descriptors: *Water pollution effects, *English sole, *Cadmium, *Polychlorinated biphenyls, *Aroclor, *Diesel fuel, *Seawater, *Toxicity, Hepatocellular necrosis, Liver regeneration, Karyomegaly, Aspartate aminotransferase, Enzymes, Calcium, Serum, Bioassay, Interactions, Metabolism.

Juvenile English sole were exposed orally to cadmium chloride and Aroclor 1254 (polychlorinated biphenyl, PCB), either independently or simultaneously, for 4 wk, followed by exposure to seawater-accomodated No. 2 diesel fuel for 2 wk. Hepatocellular necrosis, regeneration, and karyomegaly were observed. Differential lesion prevalences were observed among the exposure groups, with high proportions among Cd-exposed fish, low proportions among PCB-exposed fish, and intermediate proportions in Cd + PCB-exposed fish. Levels of aspartate aminotransferase activity and Mg in the sera of these groups exhibited similar patterns. Depressed serum Ca levels in both PCB-exposed and Cd + PCB-exposed groups were found after the first week, and lower serum albumin concentrations occurred in all Cd- and PCB-exposed groups following the third week. Subsequent exposure to No. 2 diesel fuel produced few effects in any of the exposure groups. The observed antagonistic effect of Aroclor 1254 against cadmium toxicity emphasizes the importance of employing multiple as well as single contaminant exposure in toxicity studies. (Author's abstract)
W87-01811

EFFECTS OF MANIPULATIONS OF ALUMINUM CONCENTRATIONS AND PH ON PHOSPHATE UPTAKE AND PHOTOSYNTHESIS OF PLANKTONIC COMMUNITIES IN TWO PRECAMBRIAN SHIELD LAKES,
Toronto Univ. (Ontario). Div. of Life Sciences.
C. Nalewajko, and B. Paul.
Canadian Journal of Fisheries and Aquatic Sciences CJFSBX, Vol. 42, No. 12, p 1946-1953, December 1985. 7 fig, 3 tab, 50 ref.

Descriptors: *Water pollution effects, *Acid rain, *Aluminum, *Hydrogen ion concentration, *Phosphate uptake, *Photosynthesis, *Phytoplankton, *Toxicity, *Precambrian Shield lakes, Plastic Lake, Saint Nora Lake, Canada, Precipitation, Plant physiology, Acidification.

From June 1982 to October 1983, the physiological response of phytoplankton to Al perturbations were studied in a circumneutral lake (St. Nora Lake) and an acid-stressed lake (Plastic Lake) on the Precambrian Shield in Ontario (Canada). In both lakes, addition of Al to water samples decreased microbial phosphate uptake and photosynthesis; significant decreases occurred at 50 microgram Al/liter. Both processes were affected more at pH 5.2-6.9 than at pH 4.5, although the absolute rates of these processes at pH 4.5 were substantially lower. Phosphate uptake was depressed relatively more than photosynthesis, and depression of both processes was larger in Plastic Lake than in St. Nora Lake. Precipitation of phosphate as particles >0.45 micron upon addition of Al, as well as direct toxicity of Al, appear to be responsible for the observed detrimental effects of Al. (Author's abstract)
W87-01814

PHYSIOLOGICAL RESPONSE OF JUVENILE RAINBOW TROUT, SALMO GAIRDNERI, TO ACID AND ALUMINUM - PREDICTION OF FIELD RESPONSES FROM LABORATORY DATA,
Ontario Ministry of the Environment, Rexdale. Aquatic Toxicity Unit.
C. M. Neville.
Canadian Journal of Fisheries and Aquatic Sciences CJFSBX, Vol. 42, No. 12, p 2004-2019, December 1985. 7 fig, 5 tab, 46 ref, append.

Descriptors: *Acid rain, *Fish behavior, *Hydrogen ion concentration, *Aluminum, *Rainbow trout, *Juvenile growth stage, *Fish kills, Mortality, Hypoxia, Electrolyte loss, Norway, North America, Refuges, Prediction, Interspecific variation, Sublethal effects.

An initial 1- to 2-hr exposure of juvenile rainbow trout to 2.8 uM (micromole/liter) inorganic Al caused increased ventilation and activity responses ranging from slight to severe, depending on th ambient pH. The severity of physiological response after 6-11 days of exposure resembled that of the initial response. This was severe at pH 6.1, 4.5, and 4.0, slight to moderate at pH 5.0 and 5.5, but minimal at pH 6.5. In the severe response groups, 40-90% of the fish died after a few days of exposure. Death was due primarily to hypoxia at pH 6.1 and to electrolyte loss at pH 4.5 and 4.0. Between pH 5.5 and 5.0, there was a transition between the two mechanisms. With 8-10 mg natural organic acids/liter, the response to the same concentration of inorganic Al was unchanged at pH 5.0, but was slightly increased at pH 4.5. Fish kills of salmonids that have occurred in South Norway could have been predicted from these results. In North America the presence of refuge areas and the prevalence of more tolerant species could account for the occurrence of sublethal rather than lethal responses. (Author's abstract)
W87-01818

ACIDIFICATION AND TOXICITY OF METALS TO AQUATIC BIOTA,
Institut National de la Recherche Scientifique, Sainte-Foy (Quebec).
P. G. C. Campbell, and P. M. Stokes.
Canadian Journal of Fisheries and Aquatic Sciences CJFSBX, Vol. 42, No. 12, p 2034-2049, December 1985. 12 tab, 103 ref.

Descriptors: *Acid rain, *Acidification, *Toxicity, *Metals, *Aquatic, *Hydrogen ion concentration, Silver, Aluminum, Cadmium, Cobalt, Mercury, Manganese, Nickel, Lead, Zinc, Copper, Lead, Metal speciation, Ions.

Possible effects of environmental acidification (pH 7-4) are reviewed on: (1) metal speciation in solution; (2) metal adsorption at biological surfaces; and (3) metal uptake by and toxicity to aquatic biota. Attention was focused on some 10 metals of potential concern in the context of freshwater acidification (Ag, Al, Cd, Co, Cu, Hg, Mn, Ni, Pb, and Zn). For the four metals (Al, Cu, Hg, and Pb) predicted to manifest speciation changes in the range pH 7-4, confirmatory experimental data were available for Cu and Pb. In the six remaining cases predicted to show little sensitivity to pH changes in this range, supporting experimental evidence exists for Ag, Cd, Mn, and Zn. A pH-dependent biological response is documented over a realistic range of H(+) and metal concentrations for Al, Cd, Cu, Zn, and to a lesser extent, Hg and Pb. These metals fall into two groups: those for which a decrease in pH results in decreased biological response (type I behavior: Cd, Cu, and Zn) and those for which the dominant effect of acidification is increased metal availability (type II behavior: Pb). Data for Al and Hg clearly reveal pH effects, but the results are too few and too inconsistent to allow generalizations. (Author's abstract)
W87-01819

BIOGEOGRAPHIC INFLUENCES ON FISH SPECIES COMPOSITION OF NORTHERN WISCONSIN LAKES WITH APPLICATIONS FOR LAKE ACIDIFICATION STUDIES,
Ohio State Univ., Columbus. Dept. of Zoology.
F. J. Rahel.
Canadian Journal of Fisheries and Aquatic Sciences CJFSBX, Vol. 43, No. 1, p 124-134, January 1986. 4 fig, 4 tab, 34 ref, append.

Descriptors: Acid rain, *Water pollution effects, *Lakes, *Fish, *Acidification, *Wisconsin, *Species-area regression, *Alkalinity, Lake size, Isolation, Hydrogen ion concentration, Extinctions, Biogeography, Perch, Mathematical models, Prediction.

In 100 northern Wisconsin lakes, the species-area regression for alkaline lakes (>10 mg/l as CaCO3) had higher intercept and greater slope than the regression for low-alkalinity, but unacidified lakes. Thus, low-alkalinity lakes had fewer species than alkaline lakes, and added species at a slower rate as lake size increased. Biogeographic factors (lake size, alkalinity, isolation from other water bodies) strongly influenced fish community composition. Small lake size appeared to exclude species requiring wave-washed, rock substrates and species preferring cool, well-oxygenated water; such habitat is limited in small lakes. Low alkalinity and associated chemical conditions (eg, low pH) limited the occurrence of many cyprinids and some percids (genus Etheostoma). Lake isolation (no inlet and outlet streams) appeared to have a limited effect on species composition. An exception was the reduced occurrence, in lakes without tributary streams, of species that spawn in flowing water. Fish distributions among Wisconsin lakes provide a test of habitat requirements proposed for other geographic regions. Species-area relations, used to predict losses of fish populations in acidified lakes, may overestimate the number of extinctions if regression equations developed from unacidified (high-alkalinity) lakes are used to predict the number of species previously present in acidified (low-alkalinity) lakes. (Author's abstract)
W87-01824

RECENT MAJOR DECLINES IN ZOOPLANKTON POPULATIONS IN THE INSHORE REGION OF LAKE MICHIGAN: PROBABLE CAUSES AND IMPLICATIONS,
Michigan Univ., Ann Arbor. Great Lakes Research Div.
For primary bibliographic entry see Field 2H.
W87-01826

MODIFICATION OF BIOACCUMULATION OF SELENIUM BY MYTILUS EDULIS IN THE PRESENCE OF ORGANIC AND INORGANIC MERCURY, (MODIFICATION DE LA BIOACCUMULATION DU SELENIUM CHEZ MYTILUS EDULIS EN PRESENCE DU MERCURE ORGANIQUE ET INORGANIQUE),
Institut National de la Recherche Scientifique, Rimouski (Quebec).
E. Pelletier.
Canadian Journal of Fisheries and Aquatic Sciences CJFSBX, Vol. 43, No. 1, p 203-211, January 1986. 6 fig, 2 tab, 35 ref. NSERC (Canada) Grant RD0329.

Descriptors: *Selenium, *Blue mussel, *Bioaccumulation, *Mercury, *Toxicity, Seawater, Methyl mercury, Organic selenium, Culture tanks.

Rates of bioaccumulation of dissolved selenite (Na2SeO3) and adsorbed organic selenium (C8H7O2Se)2 were measured in the blue mussel and the impact on bioaccumulation of the presence of environmental mercury (HgCl2 and ((CH3Hg)3O)OH)) was determined. Mussels 3.6 + or - 0.2 cm in diameter in continuously circulating seawater were exposed to organic and inorganic Se at a concentration of 50 microgram/liter (ug/l) for periods of 15-50 days. Mussels in some tanks were exposed simultaneously to inorganic and organic Hg at concentrations of 3.0 and 30 ug/l, respectively. When Hg was absent, the mussels accumulated inorganic Se at a rate of 0.12 nanogram (ng) Se/g per day, but did not accumulate organic Se. In the presence of inorganic Hg at 30 ug/l, the accumulation rate of inorganic Se doubled, and it tripled when methyl Hg was added at 3.0 ug/l. Even the adsorbed organic Se seemed to become available in the presence of methyl Hg, and was accumulated at a rate of 0.15 ng Se/g per day. The phenomenon was not reciprocal, however: Se, no matter what its concentration or chemical nature, had no effect on the accumulation rate of Hg. No toxic effects were observed when Se was administered alone, but the toxic effects of Hg were observed in all animals exposed to it. (Author's abstract)
W87-01827

HISTOLOGICAL CHANGES IN CULTURED LAKE TROUT, SALVELINUS NAMAYCUSH, SUBJECTED TO CUMULATIVE LOADING IN A WATER REUSE SYSTEM,
National Fishery Research and Development Lab., Wellsboro, PA.
J. W. Meade, and R. L. Herman.
Canadian Journal of Fisheries and Aquatic Sciences CJFSBX, Vol. 43, No. 1, p 228-231, January 1986. 4 fig, 13 ref.

Descriptors: *Water pollution effects, *Water reuse, *Lake trout, *Ammonia, *Rainbow trout, *Gills, *Aluminum, Hyperplasia, Hypertrophy, Pathology, Lamellar telangiectasis, Fish rearing, Serial reuse units, Toxicity.

Lake trout, 16 cm long, were reared 8 wk in five serial reuse units, resulting in cumulative loadings of 1.5-7.5 kg fish/liter per min. Although mean unionized ammonia concentrations in the highest loading levels were less than 10% of those often considered as safe for culture of rainbow trout (Salmo gairdneri), lake trout reared at the higher loading levels showed dilation of glomerular capillaries, which persisted after cumulative loading conditions were removed, and gill epithelial hyperplasia and hypertrophy. Lamellar telangiectasis was caused by sampling technique (concussion). The authors conclude that factors other than ammonia concentrations are significant in branchial irritation. (Author's abstract)
W87-01828

ACCLIMATION-INDUCED CHANGE IN TOXICITY OF ALUMINUM TO RAINBOW TROUT (SALMO GAIRDNERI),
Guelph Univ. (Ontario). Dept. of Zoology.
P. L. Orr, R. W. Bradley, J. B. Sprague, and N. J. Hutchinson.
Canadian Journal of Fisheries and Aquatic Sciences CJFSBX, Vol. 43, No. 1, p 243-246, January 1986. 1 fig, 23 ref.

Descriptors: *Rainbow trout, *Juvenile growth stage, *Aluminum, *Toxicity, *Acclimation, *Tolerance, *Seasonal variation, *Acidification, Hydrogen ion concentration, Artificial lakes, Hardness, Survival.

When a group of rainbow trout fingerlings were exposed to 87 microgram (ug) Al/l for 1 and 2 wk, the threshold lethal concentration (LC50) increased to about 1.8 times the control LC50 of 175 ug/l. Raising sublethal exposure to 154 ug/l during the third week resulted in a similar ratio, of 1.7, between LC50s of previously exposed and control fish. Thus, prior exposures of 0.5 and 0.9 of the control LC50 resulted in about the same increase in tolerance. The magnitude of the increase was similar to those reported in the literature for other metals. Such acclimation could assist in the survival of fish during spring and autumn surges of Al and other metals in surface waters acidified by atmospheric deposition of oxides of sulfur and nitrogen, in which environmental changes in Al concentration parallel those employed here. Experimental water simulated an acid lake with pH 5.1-5.3 and total hardness of 11 mg/l. (Author's abstract)
W87-01829

EFFECTS OF CHRONIC EXPOSURE TO SUBLETHAL PH ON GROWTH, EGG PRODUCTION, AND OVULATION IN BROOK TROUT, SALVELINUS FONTINALIS,
University of Western Ontario, London. Dept. of Zoology.
W. H. Tam, and P. D. Payson.
Canadian Journal of Fisheries and Aquatic Sciences CJFSBX, Vol. 43, No. 2, p 275-280, February 1986. 5 fig, 4 tab, 13 ref. National Research Council (Canada) D.S.S. Contract 20SU-31048-3-13644.

Descriptors: *Acidic water, *Water pollution effects, *Hydrogen ion concentration, *Toxicity, *Chronic exposure, *Brook trout, Seasonal variation, Growth, Reproduction, Egg development, Ovulation, Fish eggs, Fish physiology.

Hatchery-reared brook trout were maintained in the laboratory at mean pH values of 7.34, 5.56, and 4.48 from early February to early December. At pH 4.48, the mean growth rates of males were uniformly lowered during the entire experimental period. Among females, growth was inhibited during the first 5 mo, but their rate of weight gain recovered during the period of rapid oocyte development. At the end of the experiment, the body weights of both male and female fish in pH 5.16 and 4.48 were only 70.70-77.34% of the control fish at pH 7.34. Growth was not affected by exposure to pH 5.56. Rapid oocyte development occurred simultaneously over all pH groups in June, suggesting that the initiation of gametogenesis was not affected over the range of pH tested. The number of eggs produced by the smaller pH 5.16-4.48 females was reduced. Ovulation was delayed significantly in the acidic groups. (Author's abstract)
W87-01846

LAKE ACIDIFICATION AS A LIMITING FACTOR IN THE DISTRIBUTION OF THE FRESHWATER AMPHIPOD HYALELLA AZTECA,
Guelph Univ. (Ontario). Dept. of Zoology.
For primary bibliographic entry see Field 5B.
W87-01847

PHOSPHORUS ENRICHMENT, SILICA UTILIZATION, AND BIOGEOCHEMICAL SILICA DEPLETION IN THE GREAT LAKES,
Michigan Univ., Ann Arbor. Great Lakes Research Div.
For primary bibliographic entry see Field 2H.
W87-01855

LIMNETIC ZOOPLANKTON ASSEMBLAGES IN ATLANTIC CANADA WITH SPECIAL REFERENCE TO ACIDIFICATION,
Waterloo Univ. (Ontario). Dept. of Biology.
For primary bibliographic entry see Field 5B.
W87-01857

EFFECTS OF PLACER GOLD MINING ON PRIMARY PRODUCTION IN SUBARTIC STREAMS OF ALASKA,
Alaska Univ., Anchorage. Arctic Environmental Information and Data Center.
For primary bibliographic entry see Field 5B.
W87-01892

ALGAL BIOASSAY AND GROSS PRODUCTIVITY EXPERIMENTS USING SEWAGE EFFLUENT IN A MICHIGAN WETLAND,
Duke Univ., Durham, NC. School of Forestry and Environmental Studies.
C. J. Richardson, and B. R. Schwegler.
Water Resources Bulletin WARBAQ, Vo. 22, No. 1, p 111-120, February 1986. 5 fig, 4 tab, 53 ref. NSF Grant AEN75-08855.

Descriptors: *Water pollution effects, *Bioassay, *Algae, *Ecosystems, Sewage effluent, Michigan, Cladophera, Fen, Nitrogen, Phosphorus, Gross productivity.

One component of the filamentous algal community of a northern fen ecosystem in central Michigan was studied under conditions of nutrient enrichment by secondarily treated sewage effluent during one growing season. The productivity of Cladophora spp. measured by continuous flow bioassay was 2.6 g dry weight/sq m/day at the site of effluent addition compared to 0.085 g/sq m/day at the control site. Under conditions of nutrient enrichment, uptake by bioassay Cladophora spp. averaged 12 mg/sq m/day for phosphorus and 55 mg/sq m/day for nitrogen, compared to 0.01 mg/sq m/day and 0.17 mg/sq m/day for phosphorus and nitrogen, respectively in the control area. At the end of the growing season approximately 4.3 g N/sq m and 0.96 g P/sq m were immobilized in Cladophora algal biomass. Algal growth temporarily immobilized 3 percent of the nitrogen and 1 percent of the phosphorus added as sewage effluent. Gross productivity, community respiration and reseration constant values in the fen were similar to data collected by other researchers in shallow water aquatic systems, but only at the fertilized sites. (Author's abstract)
W87-01894

PREDICTIVE MODELS FOR THE BIOMASS OF BLUE-GREEN ALGAE IN LAKES,
North Carolina Univ. at Chapel Hill. Dept. of Biology.
For primary bibliographic entry see Field 2H.
W87-01915

EFFECTS OF COAL PILE RUNOFF ON STREAM QUALITY AND MACROINVERTEBRATE COMMUNITIES,
Maryland Univ., Frostburg. Appalachian Environmental Lab.
For primary bibliographic entry see Field 5B.
W87-01917

BENTHIC INVERTEBRATE RESPONSE TO POLLUTION ABATEMENT: STRUCTURAL CHANGES AND FUNCTIONAL IMPLICATIONS,
Missouri Cooperative Fishery Research Unit, Columbia.
For primary bibliographic entry see Field 5D.
W87-01923

LONG-TERM CHANGES IN THE BENTHIC COMMUNITY ON THE COASTAL SHELF OF PALOS VERDES, SOUTHERN CALIFORNIA,
Los Angeles County Sanitation Districts, Whittier, CA.
For primary bibliographic entry see Field 2L.
W87-01943

EFFECTS OF COPPER AND ZINC ON TWO PLANKTONIC CILIATES,
Woods Hole Oceanographic Institution, MA. Dept. of Biology.
D. K. Stoecker, W. G. Sunda, and L. H. Davis.
Marine Biology MBIOAJ, Vol. 92, No. 1, p 21-29, July 1986. 5 fig, 4 tab, 40 ref.

Descriptors: *Copper, *Zinc, *Water pollution effects, *Plankton, *Protozoa, *Heavy metals, Aquatic plankton, Zooplankton, Estuarine environment, Favella, Balanion, Toxicity, Growth, Ions, Cations.

The interactive effects of copper and zinc on two estuarine planktonic ciliates (Favella sp. and Balanion sp.) were determined in seawater media. Cupric ion caused abnormal motility in both ciliates in short-term tests, and decreased the growth rates of both species in longer-term experiments. In the short-term tests, zinc ion activity by itself did not affect the motility of the ciliates, but there were significant interactions between copper and zinc. In the longer-term experiments, the growth of Favella sp. was optimal at the lowest cupric ion activity and the two lowest zinc ion activities, and copper and zinc inhibited growth at activities above these values. By contrast, optimal growth rate of Balanion sp. occurred at the highest zinc ion activity and the lowest cupric ion activities, and growth rate was reduced by low zinc ion activities. There was an antagonism between copper and zinc which was particularly pronounced in Balanion sp. (Author's abstract)
W87-01947

AVAILABLE NITROGEN AND NITROGEN CYCLING IN FOREST SOILS EXPOSED TO SIMULATED ACID RAIN,
Cornell Univ., Ithaca, NY. Dept. of Agronomy.
H. F. Stroo, and M. Alexander.
Soil Science Society of America Journal SSSJD4, Vol. 50, No. 1, p 110-114, January-February 1986. 2 fig, 2 tab, 29 ref. USDA Cooperative agreement 58-32U4-2-409.

Descriptors: *Acid rain, *Nitrogen, *Forest soils, *Decomposition, Nitrogen cycle, Fertilizers, Simulated rainfall, Potassium, Calcium, Magnesium, Iron, Aluminum, Manganese, Soil chemistry, Red oak, White pine, Microorganisms, Leaching.

The formation of NO3(-) and NH4(+) was measured in columns containing samples from the surface horizons of 12 forest soils both during and after exposure to simulated rain applied at three times the ambient deposition rates for 116 days. The relative responses to increased acidity were correlated with organic matter and N levels of the soils. The average inhibition for the 12 soils was linearly related to the amount of acidity added. The quantity of N mineralized was less in some soils after their exposure to simulated rain at pH 3.5 than at pH 5.6 and greater in other soils, but the average amount mineralized after exposure of the 12 soils was not significantly affected by the pH of the simulated rain during the treatment period. The mean percentage of the inorganic N produced in the 12 soils that was in the NO3(-) form was lower during, but not after, the exposure to simulated rain at pH 3.5 than at 5.6. The amount of inorganic N added in the simulated acid rain exceeded the diminished supply arising because of the inhibition of mineralization during the exposure. The suppression of N mineralization in Crary soil (Aquic Fragiorthods) containing white pine seedlings and in Mardin soil containing red oak seedlings was less than in unplanted soil. The simulated rain at pH 3.5 altered the amounts of K, Ca, Mg, Al, Fe, and Mn leached from the soil. Inhibition of inorganic N formation by microorganisms in short periods of acid precipitation may be compensated by the N added with the precipitation. (Author's abstract)
W87-01990

SIMULATED ACID RAIN EFFECTS ON JACK PINE SEEDLING ESTABLISHMENT AND NUTRITION,
Michigan State Univ., East Lansing. Dept. of Forestry.
N. W. MacDonald, J. B. Hart, Jr., and P. V. Nguyen.
Soil Science Society of America Journal SSSJD4, Vol. 50, No. 1, p 219-225, January-February 1986. 1 fig, 5 tab, 39 ref.

Descriptors: *Jack pine, *Simulated rainfall, *Acid rain, *Grayling sand, *Michigan, *Calcium, *Magnesium, *Seed germination, Soil horizons, Hydrogen ion concentration, Plant pathology, Seedling mortality, Nitrogen, Potassium Calcium, Sodium, Manganese, Zinc, Aluminum, Phosphorus, Magnesium.

A 75-day greenhouse study examined the effects of simulated acid rain on jack pine (Pinus banksiana Lamb.) seedling development and the Grayling sand (Typic Udipsamments) growth medium. Five levels of rain pH (2.0, 2.5, 3.0, 4.0, and 4.7) and two soil horizons (A/E, Bw1) were included as levels of factors. Soil pH decreased only at rain pH 3.0 and below. Exchangeable Ca and Mg were reduced at pH 2.0 in A/E horizon soil only. Germination of jack pine was inhibited at pH 2.0 on both soils. Mortality of germinants was over 95% on both soils at pH 2.0, 42% on A/E soil at pH 2.5, and 2-13% in other treatment combinations. Seedling top weight increased and root weight decreased on both soils at pH 2.5. In seedlings grown at pH levels 2.5 to 4.7, tissue concentrations of N, K, Ca, Na, Mn, Zn, and Al increased, but P and Mg were reduced, as rain pH decreased. Simulated rain approximating pH levels typical of northern lower Michigan (>3.0) did not affect adversely the regeneration of jack pine or soil properties of the Grayling sand during the present study. (Author's abstract)
W87-02000

DYNAMICS OF EXTRACTABLE PHOSPHORUS DURING NONSTERILE AND STERILE INCUBATION OF SLUDGE-AMENDED SOIL,
New Mexico State Univ., Las Cruces. Dept. of Crop and Soil Sciences.
G. R. Cline, W. C. Lindemann, and R. Quintero.
Soil Science SOSCAK, Vol. 140, No. 2, p 98-104, August 1985. 6 fig, 2 tab, 26 ref. DOE Contract DE-AC04-76ET-33626.

Descriptors: *Phosphorus, *Soil amendments, *Land disposal, *Sludge disposal, Sewage sludge, Clay, Sand, Glendale soil, Latene soil, Sterile soils, Gamma radiation, Autoclaving, Soil chemistry.

A clayey soil (Glendale) and a sandy soil (Latene) were amended with three rates (0, 15, and 30 g/kg) of gamma-irradiated, dried, anaerobically digested sewage sludge and 300-g samples were incubated for 84 days at 35 C and 0.03 MPa moisture tension. NaHCO3- and H2O-extractable P were determined periodically. In subsequent experiments, Glendale soil was sterilized by either gamma-irradiation or autoclaving to study the effects of microbial activity on NaHCO3-P and H2O-P. Sludge amendment significantly increased NaHCO3-P levels in both soils throughout the 84-day incubation period. NaHCO3-P values for both soils were related directly to the amount of sludge added. A rapid rise in NaHCO3-P occurred in the first week of incubation, with fairly steady values thereafter. Levels of NaHCO3-P were higher in the Glendale soil at all treatment levels over the 7-84 day period. Soil sterilization by irradiation did not affect either NaHCO3-P or H2O-P levels compared to nonsterilized soil, but autoclaving had a much greater effect on indigenous P than irradiation. NaHCO3-P and H2O-P increases in sludge-amended soils are the result of chemical rather than microbial transformations. (Author's abstract)
W87-02008

EFFECT OF SIMULATED ACID RAIN ON NITRATE AND AMMONIUM PRODUCTION IN SOILS FROM THREE ECOSYSTEMS OF CAMELS HUMP MOUNTAIN, VERMONT,
Vermont Univ., Burlington. Dept. of Plant and Soil Science.
D. E. Like, and R. M. Klein.
Soil Science SOSCAK, Vol. 140, No. 5, p 352-355, Novemvber 1985. 2 fig, 20 ref.

Descriptors: *Acid rain, *Water pollution effects, *Nitrification, *Ecological zonation, *Hardwoods, *Conifers, *Mountains, *Vermont, Camels Hump, Hydrogen ion concentration, Simulated rainfall,

Nitrates, Ammonium, Soil chemistry, Forest soils, Mountain spodosols.

Intact soil (mountain Spodosol) columns were removed from three ecological zones of Camels Hump, Vermont, treated with simulated acid rain (pH 4.0) or nonacidic rain (pH 5.6), and the percolates were examined for ammonium and nitrate ions. Nitrification in soils from all three ecosystems was unaffected by acidic treatments, but mineralization was stimulated by acidic treatment of the hardwood-conifer transition zone (790-1,050 m). Irrespective of treatment, conifer zone (1,050-1,160 m) soils released less nitrate than did either transition or hardwood zone (550-790 m) soils. Soil columns from the hardwood zone were treated with acidic or nonacidic simulated rainfall, supplemented with nitrate, ammonium, or both N sources. NO3-N in percolates increased when acidic simulated rain was supplemented with ammonium ion or both ammonium and nitrate ions. Efflux of NH4-N was unaffected by supplementing precipitation with either ammonium or nitrate ions. (Author's abstract)
W87-02018

CONTRASTING RESPONSE TO SIMULATED ACID RAIN OF LEAVES AND COTYLEDONS OF CABBAGE (BRASSICA OLERACEA L.),
Toronto Univ. (Ontario). Dept. of Botany.
S. J. M. Caporn, and T. C. Hutchinson.
New Phytologist NEPHAV, Vol. 103, No. 2, p 311-324, June 1986. 5 fig, 4 tab, 33 ref.

Descriptors: *Simulated rainfall, *Acid rain, *Leaves, *Cabbage, *Air pollution effects, Vegetation effects, Rainfall, Precipitation.

Cabbage (Brassica oleracea) was exposed to simulated rains delivered as sprays at pH 5.6-2.8. A single rain treatment of pH 3.0 given to 10-day-old plants elicited a marked downward curvature in the cotyledons, occurring within the duration of the 30-minute spray. The cotyledon surface was extensively damaged. In contrast, the older, true leaves showed little or no injury after similar treatments. Investigation revealed that the contrasting morphology of the epicuticular wax on cotyledons and leaves was a major factor determining the extent of acid rain damage. Simulated rain treatments of pH 3.2 and 2.8, starting at the cotyledons stage, reduced plant growth by 17 and 15%, respectively, over a 20-day period. The same treatments given at later stages in development had no significant effect on growth. The young, seedling stage of species, such as B. oleracea, in which cotyledons show poor development of surface wax, may be particularly vulnerable to the effects of acid rain. It is concluded that, in the natural environment, the occurrence of highly acidic rain events during different stages of plant development may be an important determinant of the impact of rainfall on vegetation. (Doria-PTT)
W87-02081

DIFFERENTIAL SENSITIVITY OF DUCKWEEDS (LEMNACEAE) TO SULPHITE - I. CARBON ASSIMILATION AND FROND REPLICATION RATE AS FACTORS INFLUENCING SULPHITE PHYTOTOXICITY UNDER LOW AND HIGH IRRADIANCE,
Bowling Green State Univ., OH. Dept. of Biological Sciences.
B. K. Takemoto, and R. D. Noble.
New Phytologist NEPHAV, Vol. 103, No. 3, p 525-539, July 1986. 4 fig, 5 tab, 45 ref.

Descriptors: *Duckweed, *Aquatic plants, *Air pollution effects, *Water pollution effects, *Sulfites, *Toxicity, *Carbon, *Leaves, *Phytotoxicity, Sulfur compounds, Vegetation effects, Plant physiology, Chlorophyll, Photosynthesis, Respiration.

The relationship between the inhibition of frond replication caused by sulfite, and changes in carbon assimilation, and the role of irradiance in modifying carbon assimilation and sensitivity to sulfite was studied in three species of duckweed to assess the responses of aquatic vascular plants to sulfite enrichment. Under low irradiance, inhibition of frond replication by sulfite was most pronounced in Lemna gibba, and less marked in Spirodela oligorhiza. Lemna valdiviana was not affected. In all species, chlorophyll content increased in response to sulfite enrichment. Photosynthesis and dark respiration rates were reduced in all species by sulfite, while ribulose bisphosphate carboxylase activity on a soluble protein basis was increased up to 13%. Reduced carbon assimilation may have contributed to decreased frond replication in L. gibba and S. oligorhiza. In all species, photosynthesis and ribulose bisphosphate carboxylase activity were enhanced under high irradiance. The responses to elevated light appear to have contributed to faster rates of frond replication in all three species, and reduced sensitivity of frond replication to sulfite in L. gibba and S. oligorhiza. It is postulated that the stimulation of carbon assimilation under high irradiance is an important physiological response contributing to the modification by the photoenvironment of the sensitivity of duckweeds to sulfite. (See also W87-02083) (Doria-PTT)
W87-02082

DIFFERENTIAL SENSITIVITY OF DUCKWEEDS (LEMNACEAE) TO SULPHITE - II. THIOL PRODUCTION AND HYDROGEN SULPHIDE EMISSION AS FACTORS INFLUENCING SULPHITE PHYTOTOXICITY UNDER LOW AND HIGH IRRADIANCE,
Bowling Green State Univ., OH. Dept. of Biological Sciences.
B. K. Takemoto, R. D. Noble, and H. M. Harrington.
New Phytologist NEPHAV, Vol. 103, No. 3, p 541-548, July 1986. 3 tab, 25 ref.

Descriptors: *Duckweed, *Aquatic plants, *Air pollution effects, Water pollution effects, *Sulfites, *Hydrogen sulfide, *Phytotoxicity, *Thiols, *Detoxification, Vegetation effects, Metabolism, Toxicity, Plant physiology, Phytotoxicity.

The relationship of selected parameters of sulfite metabolism to sulfite sensitivity in duckweeds was determined, along with the role of irradiance in modifying the metabolic effects of sulfite. The ability to form elevated internal levels of thiols and to emit H2S were found to be important in relation to sulfite tolerance in duckweeds. Enhancement of both processes under high irradiance may contribute to increased tolerance of sulfite in L. gibba and S. oligorhiza. It is hypothesized that thiol production and emission of H2S are important sulfite detoxification processes in duckweeds, and that enhancement of sulfite detoxification is fundamental to the modification by the photoenvironment of the sensitivity of duckweeds to sulfite. (See also W87-02082) (Doria-PTT)
W87-02083

FATE OF THIOBENCARB AND MOLINATE IN RICE FIELDS,
California Dept. of Food and Agriculture, Sacramento.
For primary bibliographic entry see Field 5B.
W87-02086

PH BUFFERING IN FOREST SOIL ORGANIC HORIZONS: RELEVANCE TO ACID PRECIPITATION,
New York State Agricultural Experiment Station, Geneva.
For primary bibliographic entry see Field 5B.
W87-02088

PROTON AND METAL COMPLEXATION BY WATER-SOLUBLE LIGANDS EXTRACTED FROM ANAEROBICALLY DIGESTED SEWAGE SLUDGE,
Oregon State Univ., Corvallis. Dept. of Soil Science.
For primary bibliographic entry see Field 5E.
W87-02089

EFFECT OF SLUDGE ADDITIONS ON NITROGEN REMOVAL IN SOIL COLUMNS FLOODED WITH SECONDARY EFFLUENT,
Agricultural Research Service, Durant, OK. Water Quality and Watershed Research Lab.
For primary bibliographic entry see Field 5E.
W87-02096

INFLUENCE OF SULFATE, NITRATE, AND CHLORIDE IN SIMULATED ACIDIC RAIN ON RADISH PLANTS,
California Dept. of Food and Agriculture, Sacramento.
For primary bibliographic entry see Field 5B.
W87-02097

EFFECTS OF VASCULAR AND NONVASCULAR MACROPHYTES ON SEDIMENT REDOX AND SOLUTE DYNAMICS,
Notre Dame Univ., IN. Dept. of Biological Sciences.
For primary bibliographic entry see Field 2H.
W87-02100

ORGANOCHLORINE RESIDUES IN FINFISH FROM MARYLAND WATERS, 1976-1980,
Maryland Dept. of Health and Mental Hygiene, Baltimore.
For primary bibliographic entry see Field 5B.
W87-02133

EFFECT OF NUTRIENTS ON SHOOT BIOMASS AND SPECIES COMPOSITION OF WETLAND AND HAYFIELD COMMUNITIES,
Utrecht Rijksuniversiteit (Netherlands). Dept. of Plant Ecology.
H. G. Vermeer.
Acta Ecologica AOSPDY, Vol. 7, No. 1, p 31-41, 1986. 4 fig, 2 tab, 30 ref.

Descriptors: *Nutrients, *Eutrophication, *Peat bogs, *Grasslands, *Plant growth, *Species composition, *Wetlands, *Hayfields, *Biomass, Vegetation establishment, Fertilization, Nitrogen, Grasses, Phosphorus, Potassium, Netherlands.

The effects of increased nutrient availability on shoot biomass and species composition of a fen, a wet grassland and a hayfield in the Netherlands was studied to determine which nutrients limit plant growth. Four treatments were applied in a field experiment. The fen and wet grassland plots fertilized with nitrogen produced larger aboveground biomass than unfertilized plots, but nitrogen and phosphorus concentrations in shoot biomass were low for both treatments, indicating a low supply of nutrients. Shoot biomass in hayfield plots supplied with potassium was significantly larger. This was consistent with results found for nutrient concentrations in the plant material. Addition of nutrients also affected the proportional biomass concentration of individual species to total above-ground biomass. The concentration of grasses in the fen increased after addition of nitrogen, while all fertilization treatments increased the proportion of grasses in the wet grassland. There appears to be no relationship between increasing nutrient availability and species diversity in the plant communities studied. (Michael-PTT)
W87-02135

TOXICITY VS. MUTAGENICITY OF SOME CRUDE OILS, DISTILLATES AND THEIR WATER SOLUBLE FRACTIONS,
Bedford Inst. of Oceanography, Dartmouth (Nova Scotia). Marine Ecology Lab.
J. H. Vandermeulen, A. Foda, and C. Stuttard.
Water Research WATRAG, Vol. 19, No. 10, p 1283-1289, 1985. 5 tab, 30 ref.

Descriptors: *Toxicity, *Water pollution effects, *Mutagenicity, *Oil pollution, *Oil, Oil characterization, Oil wastes, Oily water, Acetone, Methanol, Hexane.

Ames tests were conducted on a range of oils and oil products which confirmed the mutagenicity of used motor oil, but showed either toxicity or no significant mutagenicity for the other oils. Water soluble fractions (WSF) of all products, including used motor oil, gave no significant indications of

mutagenicity, but in several tests, which included whole products and WSF, a ratio of induced revertants to spontaneous revertants was obtained which exceeded non-mutagenic background levels. Parallel assays of chromatographically obtained fractions showed significant mutagenicity in the F4 (acetone or methanol) fraction which was assumed to be a strongly polar, DMSO-soluble large molecular weight component of Kuwait crude oil. This mutagenicity was not enhanced by metabolic activation. No other fraction showed evidence of mutagenicity, but there was marked toxicity associated with the hexane fraction. Low mutagenicity scores could result from the masking of mutagenic activity by the toxicity of other components of oil and oil products. (Author's abstract)
W87-02158

INJURY AND REPAIR OF ESCHERICHIA COLI DAMAGED BY ACID MINE WATER,
West Virginia Univ., Morgantown. Div. of Plant and Soil Sciences.
A. T. Wortman, and G. K. Bissonnette.
Water Research WATRAG, Vol. 19, No. 10, p 1291-1297, 1985. 4 fig, 33 ref.

Descriptors: *Escherichia coli, *Water pollution effects, *Acid mine drainage, Hydrogen ion concentration, Temperature effects, Bacteria, Oxygen requirements, Nutrients.

Pure culture suspensions of E. coli were stressed by exposure to acid mine water and the ability of sublethally damaged survivors to repair in several resuscitation media under differnt pH, temperature and oxygen availability conditions was examined. The repair process was monitored as a function of time by simultaneously plating samples in selective and nonselective media. It was found that E. coli was severely damaged by acid mine water, but that injured survivors repaired when placed under favorable conditions. Optimal repair occurred in trypticase soy broth supplemented with 0.3% yeast extract (TSYB) at pH 7.0 and 35 C. Resuscitation did not occur in TSYB at pH 9.0, at 20 C or in the absence of oxygen. Laurel tryptose broth (LTB), which is recommended for fecal coliform isolation, did not facilitate repair. The presence of the surfactant sodium dodecyl sulfate and the nutrient composition of LTB appeared to be responsible for this medium's inability to permit recovery of acid mine water-stressed E. coli. (Author's abstract)
W87-02159

VARIATION OF THE BLOOD LEAD LEVEL AS A RESULT OF LEAD CONTAMINATION OF THE SUBJECTS DRINKING WATER (VARIATION DE LA PLOMBEMIE EN FOUCTION DE LA CONTAMINATION PAR LE PLOMBM DE L'EAU LIVREE A LA CONSOMMATION),
Direction Dept. des Affaires Sanitaires et Sociales des Vosges, Epinal (France).
X. Bonnefoy, G. Huel, and R. Gueguen.
Water Research WATRAG, Vol. 19, No. 10, p 1299-1303, 1985. 1 fig, 3 tab, 23 ref. Ministry of Health (France) Grant 76368K.

Descriptors: *Lead, *Drinking water, *Blood, *Contamination, France, Public health, Epidemiology, Water sampling, Atomic adsorption spectrophotometry.

Blood samples and drinking water samples were randomly taken from 321 residents of the Vosgian Mountains in France where a high incidence of lead poisoning cases was reported. Blood and water samples were analyzed by electrothermal atomization-atomic adsorption spectrophotometry and a logarithmic transformation was performed because of the log-normality of the distributions of blood lead levels and concentrations of lead in the drinking water. Among the study subjects, 28% were served by water containing a higher amount of lead than the allowable standard for France, and 48% had drinking water lead concentrations higher than the European and World Health Organization standard. The study indiciated higher blood lead levels in men than in women and there were significant blood lead level differences between the Vosgian residents and other urban populations. A threshold value was identified that establishes the relationship between blood lead levels and lead contamination of drinking water supplies. (Michael-PTT)
W87-02160

DECOMPOSITION OF LAKE PHYTOPLANKTON. 2. COMPOSITION AND LABILITY OF LYSIS PRODUCTS,
For primary bibliographic entry see Field 2H.
W87-02172

POTENTIALLY TOXIC CONCENTRATIONS OF TRIETHYL LEAD IN BLACK FOREST RAINWATER SAMPLES,
Max-Planck-Inst. fuer Medizinische Forschung, Heidelberg (Germany, F.R.). Abt. Physiologie.
For primary bibliographic entry see Field 5A.
W87-02175

DENSITY STRATIFICATION IN IONICALLY ENRICHED ONONDAGA LAKE, U.S.A.,
Upstate Freshwater Inst., Inc., Syracuse, NY.
S. W. Effler, E. M. Owens, and K. A. Schimel.
Water, Air, and Soil Pollution WAPLAC, Vol. 27, No. 3/4, p 247-258, 1986. 8 fig, 30 ref.

Descriptors: *Water pollution effects, *Density stratification, *Ionically enriched water, *Onondaga Lake, Thermal stratification, Chemical stratification, Isotherms, Isopleths, Salinity, Temperature profiles, Chloride profiles, Ionic waste, Lake stratification.

Density stratification was characterized in ionically enriched Onondaga Lake during a 7-month period in 1980. The characterization was based on paired profiles of temperature and chloride collected at 1 m depth intervals from a single deep water location on 34 different occasions. The lake was both thermally and chemically stratified. The chemical component represented 38.5% of the density stratification for the study period. It was most often the dominant component in establishing the depth of the upper mixed layer, which was unusually shallow in the lake. Further, the presence of the chemical component prolonged the stratification period. The chemical component of stratification decreased progressively through the study. The altered stratification characteristics of the lake may have negative effects on the level of biomass in the upper waters and the oxygen resources of the lower waters. (Author's abstract)
W87-02187

EFFECTS OF SIMULATED ACIDIC RAIN ON ONE SPECIES EACH OF PSEUDOPARMELIA, USNEA, AND UMBILICARIA,
Oak Ridge National Lab., TN. Environmental Sciences Div.
L. L. Sigal, and J. W. Johnston, Jr.
Water, Air, and Soil Pollution WAPLAC, Vol. 27, No. 3/4, p 315-322, 1986. 2 ref. EPA Interagency agreement 79-X0533, DOE Contract AC05-840R21400.

Descriptors: *Acid rain, Radiolabeling, Liquid scintilation, Tissue necrosis, Rain simulator, Lichen, Photosynthesis, Bleaching.

The lichens Pseudoparmelia caperata, Usnea cf subfusca, and Umbilicaria mammulata were exposed to simulated acidic ran with pH levels of 2.3, 3.0, 3.3, 4.4, or 5.6 and other ions in concentrations normally found in rain in the eastern United States. The pH levels of the most acidic treatments were similar to those found in fog, cloud water, and occasional rainfall events. The pH 4.3 and 5.6 treatments compared to average ambient conditions in the eastern and western United States, respectively, and caused no significant effects on photosynthesis. However, after the first week of treatment, significant effects of rain pH at the most acidic treatments on gross photosynthesis were detected in P. caperata and U. mammulata, but not in U. cf subfusca. Visible effect of injury were also observed and included bleaching, necrotic spots, and necrotic margins, which resemble damage seen in field populations of U. mammulata, the most sensitive species. (Author's abstract)
W87-02191

DENSITY OF INFLOWS TO ONONDAGA LAKE, U.S.A., 1980 AND 1981,
Upstate Freshwater Inst., Inc., Syracuse, NY.
For primary bibliographic entry see Field 5B.
W87-02201

TOXICITY AND BIOCHEMICAL RESPONSES OF CARP TO DINITROBENZENE PLANT EFFLUENT,
Indian Inst. of Tech., Bombay. Centre for Environmental Science and Engineering.
N. J. Kumar, K. P. Krishnamoorthi, and D. M. R. Rao.
Water, Air, and Soil Pollution, Vol. 28, p 117-126, 1986. 3 fig, 6 tab, 13 ref.

Descriptors: *Toxicity, *Dinitrobenzene, *Water pollution effects, *Fish physiology, Effluents, Carp, Cyprinus carpio, Ammonia, Industrial wastewater, Gas chromatography, Spectorphotometry, Fish, Oxygen consumption, Nitroaromatics.

The present work was undertaken to assess the acute and chronic effects of wastewater containing DNB (1,3 dinitrobenzene) on Cyprinus carpio. Changes in biochemical parameters such as O2 consumption, NH3 excretion, and total protein, lipid, and glycogen were also measured. The effluent was toxic even at low concentrations with 0.052% (V/V) at 96 hr LC(50). The effect of this effluent on carp reduces O2 consumption and NH3 excretion and also interferes with the metabolism of the fish. The high toxicity of the effluent is attributed to the combined effect of a mixture of nitroaromatics present in the effluent. (Main-PTT)
W87-02202

MATERIALS USAGE AND THEIR EFFECTS ON THE MICROBIOLOGICAL QUALITY OF WATER SUPPLIES,
Thames Water Authority, London (England).
For primary bibliographic entry see Field 5F.
W87-02210

BACTERIAL POLLUTION OF COASTAL WATERS IN THE UK AND MEDITERRANEAN,
Newcastle upon Tyne Univ. (England). Dept. of Civil Engineering.
L. M. Evison.
Journal of Applied Bacteriology (Symposium Supplement) JABAA4, p 81S-93S, 1985. 4 fig, 6 tab, 46 ref.

Descriptors: *Water pollution, *Coastal waters, *England, *Mediterranean Sea, Bacteria, Public health, Swimming, Shellfish, Bay of Naples, Ocean dumping, Wastewater disposal, Sludge disposal.

The bacterial pollution effects of wastewater disposal on British and Mediterranean coastal waters are compared. Health hazards associated with ocean disposal of wastewater and sludge are discussed in terms of the water quality effects on bathing areas and shellfish. The degree of sewage pollution of British coastal waters and the characteristics of sludge dumping areas are examined. Bacterial pollution of the Mediterranean Basin is discussed with regard to improvements in water quality made in the Bay of Naples. It is concluded that sewage discharge in British coastal waters poses few health hazards, but there is evidence of possible contamination of shellfish. In the Mediterranean Sea, there is a higher risk of contracting gastro-intestinal illness by swimming in polluted waters, and evidence that cholera and other infectious diseases may be transmitted through the shellfish route. (Michael-PTT)
W87-02213

POTENTIAL RISKS TO HUMAN AND ANIMAL HEALTH ARISING FROM LAND DISPOSAL OF SEWAGE SLUDGE,
North West Water Authority, Warrington (England).

For primary bibliographic entry see Field 5E.
W87-02214

ALGAL BLOOMS: CONSEQUENCES AND POTENTIAL CURES,
Dundee Univ. (Scotland). Dept. of Biological Sciences.
M. J. Daft, J. C. Burnham, and Y. Yamamoto.
Journal of Applied Bacteriology (Symposium Supplement) JABAA4, p 175S-186S, 1985. 6 fig, 4 tab, 39 ref.

Descriptors: *Predation, *Algal control, *Eutrophication, Plant viruses, Aquatic fungi, Actinomycetes, Bacteria, Amoebae, Cyanobacteria, Nutrients, Groundwater runoff.

Experiments at several lakes and reservoirs were conducted to study the effect of predation on the development of algal and cyanophycean blooms and to determine how predators can be manipulated to disturb normal growth patterns of primary algal producers. Predators such as viruses, fungi, actinomycetes, bacteria, amoebae and cyanobacteria were isolated. Interactions among prey and predators and predatory attributes were identified. It is concluded that while primary production of algal blooms is governed by the availability of nutrients from groundwater runoff, it may be possible to manipulate the balance between prey and predator to reduce algal concentrations to acceptable levels. (Michael-PTT)
W87-02218

MICROBIAL QUALITY OF WATER IN INTENSIVE FISH REARING,
Ministry of Agriculture, Fisheries and Food, Weymouth (England). Fish Diseases Lab.
B. Austin, and D. Allen-Austin.
Journal of Applied Bacteriology (Symposium Supplement) JABAA4, p 207S-226S, 1985. 5 fig, 9 tab, 128 ref.

Descriptors: *Microorganisms, *Water quality, *Fish farming, *Microbiological studies, Aquaculture, Bacteria, Pathogens, Biomass, Aquatic productivity, England, Marine fisheries.

The microbiological characteristics of water that affect the productivity of fish farming operations are reviewed. The nature of bacterial microflora present in fresh water and seawater and the bacterial microflora and bacterial pathogens present in fish tissue are discussed. The results of quantitative and qualitative studies of two fresh water fisheries and an experimental marine fish-rearing unit in England are presented, and bacterial distributions are listed. Interactions between fish raising operations and the aquatic environment are also identified. Fish may serve as early indicators of microbial pollutants in fresh water environments, but have been found to adversely affect marine environments in terms of net contribution to bacterial biomass. (Michael-PTT)
W87-02220

MICROBIOLOGICAL PROBLEMS IN THE OFFSHORE OIL AND GAS INDUSTRIES,
Heriot-Watt Univ., Edinburgh (Scotland). Dept. of Brewing and Biological Sciences.
For primary bibliographic entry see Field 4C.
W87-02221

SHORT-TERM EFFECT ON THE METABOLISM OF LOTIC BENTHIC COMMUNITIES FOLLOWING EXPERIMENTAL ACIDIFICATION,
Laval Univ., Quebec. Dept. de Biologie.
M. Allard, and G. Moreau.
Canadian Journal of Fisheries and Aquatic Sciences CJFSBX, Vol. 42, No. 10, p 1676-1680, October 1985. 1 fig, 2 tab, 19 ref.

Descriptors: *Acid rain, *Lotic environment, *Benthos, *Metabolism, *Acidification, Oxygen uptake, Biomass, Algae, Macroinvertebrates, Decomposing organic matter, Sediments, Aluminum.

Experimental acidification was performed to study its effects on the metabolism of lotic benthic communities. Oxygen uptake was lower in acidified channels than the control from the beginning to the 38th day of acidification, but by the midpoint and until the end of acidification, oxygen uptake in treated communities did not differ from control communities. The biomass of macroinvertebrates and algae were higher and the number of macroinvertebrates was lower in acidified channels by the end of the experiment. The lower total community metabolism may result in a lower decomposition rate since organic matter in sediment was higher in acidified channels with or without aluminum than in the control. Results indicate that pH is an important factor in benthic community metabolism. (Michael-PTT)
W87-02249

INTER- AND INTRA-SPECIFIC VARIABILITY IN THE RESPONSE OF ZOOPLANKTON TO ACID STRESS,
Maryland Univ., Frostburg. Appalachian Environmental Lab.
E.E. Price, and M. C. Swift.
Canadian Journal of Fisheries and Aquatic Sciences CJFSBX, Vol. 42, No. 11, p 1749-1754, November 1985. 3 fig, 2 tab, 33 ref.

Descriptors: *Acidity, *Acid rain, *Zooplankton, *Stress, Hydrogen ion concentration, Toxicity, Sulfuric acid, Seasonal variation, Maryland, North Carolina.

The toxicity of sulfuric acid to natural populations of zooplankton was measured. Organisms were collected in the spring and fall from an acid pond in North Carolina and circumneutral habitats in western Maryland, and their response to low pH was compared in 48- and 96-hour bioassays. Cladocerans were most susceptible to acid stress, followed by Mesocyclops and Chaoborus larvae. Simocephalus was the most tolerant cladoceran. Daphnia populations tested in the spring or early summer were more tolerant tolerant of low pH than in the fall. Mesocyclops edax form the acid pond were more tolerant than those from a neutral pond. The responses of the two Chaoborus species to low pH were similar during a 96-hour treatment that was two pH units lower than cladocerans and one unit lower than that of the Mesocyclops edax. These data demonstrate interspecific variability in acid sensitivity and suggest interspecific variability due to habitat and season. (Author's abstract)
W87-02251

SELENIUM REQUIREMENT OF A BLOOM-FORMING PLANKTONIC ALGA FROM SOFTWATER AND ACIDIFIED LAKES,
University of Western Ontario, London. Dept. of Plant Sciences.
J. D. Wehr, and L. M. Brown.
Canadian Journal of Fisheries and Aquatic Sciences CJFSBX, Vol. 42, No. 11, p 1783-1788, November 1985. 4 fig, 3 tab, 33 ref.

Descriptors: *Selenium, *Eutrophication, *Acid rain, *Eutrophic lakes, *Odor-producing algae, Selenites, Selenates, Dimethylselenide, Selenomethionine, Lake sediments, Bioassay, Water analysis, Ontario, Deposition, Powerplants.

The selenium requirements of a bloom-forming planktonic algae (Chrysochromulina breviturrita), the blooms of which have been associated with odor in lakes affected by acid rain, in a axenic culture is demonstrated. The alga is capable of using several forms of selenium, including selenite, selenate, dimethylselenide (DMSe) and selenomethionine. Bioassays of lake waters in Ontario show that in one lake, a simulated Se spike resulted in a significant increase in algal growth. Since microflora in aquatic sediments recycle selenium as volatile DMSe, this study makes an important contribution to understanding the biogeochemistry of acidified lakes because it represents the first demonstration of DMSe utilization by any organism. Distant coal-fired powerplants, which have been implicated in the episodic deposition of selenium, may account in part for the unpredictable blooms of the alga. (Michael-PTT)
W87-02252

SPECIES-SPECIFIC EFFECTS OF SUBLETHAL CONCENTRATIONS OF CADMIUM ON FRESHWATER PHYTOPLANKTON COMMUNITIES IN A CANADIAN SHIELD LAKE,
Kansas State Biological Survey, Lawrence.
D. C. Reinke, and F. DeNoyelles.
Canadian Journal of Botany CJBOAW, Vol. 63, No. 11, p 1997-2003, November 1985. 8 tab, 32 ref. NSF BMS 7f5-23389; Kansas Univ. Grants 4297, 4494; Kansas Univ. General Research Allocations 3678, 3207.

Descriptors: *Water pollution effects, *Sublethal effects, *Cadmium, *Phytoplankton, *Lakes, *Canada, Bioassay, Freshwater.

The species-specific effects of sublethal concentrations of cadmium on freshwater phytoplankton were measured in a Canadian Shield lake. Both in situ and laboratory cultures were studied. Asterionella formosa, Dinobryon sertularia and Dinobryon bavaricum showed dramatic negative sensitivity to low cadmium concentrations while Rhabdoderma gorskii and Elaktothrix increased in numbers at the same concentrations. Some species exhibited no reaction to cadmium additions as measured by cell counts. The similarity of the cadmium cultures to lake sample and control cultures decreased with increased cadmium levels and incubation time. The 'bottle effect' of each technique was evaluated by comparing the community similarity value of control cultures to lake samples which showed that in situ continuous cultures were most similar to the lake. The techniques involved with each bioassay system limit not only the type of data produced, but also determine the suitability of each assay system to evaluate a specific problem. (Michael-PTT)
W87-02258

EFFECTS OF O3, SO2, AND ACIDIC RAIN ON MYCORRHIZAL INFECTION IN NORTHERN RED OAK SEEDLINGS,
Boyce Thompson Inst. for Plant Research, Ithaca, NY.
P. B. Reich, A. W. Schoettle, H. F. Stroo, J. Troiano, and R. G. Amundson.
Canadian Journal of Botany CJBOAW, Vol. 63, No. 11, p 2049-2055, November 1985. 3 fig, 5 tab, 44 ref.

Descriptors: *Sulfur dioxide, *Ozone, *Infection, *Oak trees, *Acid rain, Plant pathology, Seedlings, Roots, Mycorrhizae, Air pollution, Simulated rainfall.

Northern red oak seedlings were grown in natural soils and treated with low levels of ozone, sulfur dioxide and/or acid rain to study the response of mycorrhizae to atmospheric pollutants. Seedlings were exposed to constant concentrations of ozone for five days per week and received simulated acid rain twice weekly. Ozone treatment increased the number of short roots infected with mycorrhizae per centimeter of lateral root and the percent of mycorrhizal infection. Acid rain treatments decreased the number of infected short roots and percentage infection. Plants were exposed in a field study to daily concentrations of 50, 100 and 150% of the ambient ozone concentration and received either no or five hours treatment with sulfur dioxide. Ozone increased increased numbers of short roots to be infected and increased percentage infection, while sulfur dioxide decreased numbers of infected short roots and percentage infection. The response of oak mycorrhizae to these forms of pollution are a sensitve component of the plant-soil system. Results indicate a need for more study in this area. (Michael-PTT)
W87-02260

ETHYLENE PRODUCTION BY POTATO, RADISH, AND SOYBEAN LEAF TISSUE TREATED WITH SIMULATED ACID RAIN,
Ohio Agricultural Research and Development Center, Wooster. Dept. of Plant Pathology.
C. J. Arny, and E. J. Pell.
Environmental and Experimental Botany EEBODM, Vol. 26, No. 1, p 9-15, January 1986. 6 tab, 27 ref. DOE Contract DE-AC02-77EV04331.

Descriptors: *Ethylene, *Water pollution effects,*Potatoes, *Radish plants, *Soybeans, *Acid rain, *Simulated rainfall, *Plant tissues, Gas chromatography, Leaves, Hydrogen ion concentration, Stress.

Two treatment durations and a 'no rain' treatment were used to study the ethylene production by potato, radish and soybean leaf tissue. Petioles of excised leaves were impressed in 1-aminocyclopropane-1-carboxylic acid and NaHCO3 in flasks which were sealed and incubated in the dark for 24 hours. Air was sampled and ethylene concentrations were quantified with a gas chromatograph. Potato leaves exhibited one percent injury after one hour or three one-hour treatments. Radish leaves exhibited 10-25% injury after three one hour treatments. No injury was observed at any other treatment level, and no species increased ethylene production in response to one-hour rain treatments. Plants treated at pH 2.8 generally exhibited increased ethylene production, but there appeared no direct relationship between ethylene production and treatment acidity. Regardless of treatment duration or pH, radish foliage produced more ethylene. Although ethylene production varied among species, production in response to acid rain did not appear to be an indicator of plant stress. (Michael-PTT)
W87-02265

EFFECTS OF ACIDIC RAIN AND OZONE ON NITROGEN FIXATION AND PHOTOSYNTHESIS IN THE LICHEN LOBARIA PULMONARIA (L.) HOFFM.,
Oak Ridge National Lab., TN. Environmental Sciences Div.
L. L. Sigal, and J. W. Johnston.
Environmental and Experimental Botany EEBODM, Vol. 26, No. 1, p 59-64, January 1986. 2 fig, 1 tab, 30 ref. EPA Interagency agreement 79-X0533; DOE Contract DE-AC05-840E21400.

Descriptors: *Acid rain, *Ozone, *Nitrogen fixation, *Water pollution effects, *Photosynthesis, *Lichens, Hydrogen ion concentration, Plant tissues, Simulated rainfall, Deposition.

The effects of acid rain and ozone on nitrogen fixation and photosynthesis in the lichen Lobaria pulmonaria was studied by submitting it to ozone fumigations and simulated acid rain at various pH levels for 10 days. Acid rain at pH 2.6 caused significant reductions in nitrogen fixation, gross photosynthesis and thallus bleaching was apparent. There were no significant differences in nitrogen fixation, photosynthesis, and thalli color at pH 5.6 and 4.2 treatments. Ozone effects were not significant, but there was a trend toward reduced nitrogen fixation with increased ozone concentration. There were no significant ozone-acid rain interactions. The threshold for acid rain response for this lichen is between 2.6 and 4.2, which is the acidity of wet deposition in parts of the United States. (Michael-PTT)
W87-02266

MODELING THE EFFECTS OF ACID DEPOSITION: ESTIMATION OF LONG-TERM WATER QUALITY RESPONSES IN A SMALL FORESTED CATCHMENT,
Virginia Univ., Charlottesville. Dept. of Environmental Sciences.
B. J. Cosby, R. F. Wright, G. M. Hornberger, and J. N. Galloway.
Water Resources Research WRERAO, Vol. 21, No. 11, p 1591-1601, November 1985. 7 fig, 4 tab, 48 ref. NSF Grant CEE-8215914.

Descriptors: *Acidic deposition, *Model studies, *Estimating equations, *Virginia, *Water quality, *Catchment areas, *Acid rain, *Forest watersheds, Mathematical models, Soil chemistry, Soil water, Shennandoah National Park, History, Alkalinity.

A mathematical model which quantifies soil chemical processes to estimate long term chemical changes in soil, soil water and surface waters of catchments in response to atmospheric acid deposition is presented. The model was applied to a small forested catchment in the Shenandoah National Park, Virginia where historical changes in surface water quality over the last 140 years were reconstructed. The model indicates that alkalinity of surface waters in the catchment may have been reduced by as much as 50%. When water quality is forecast under three scenarios of future changes in atmospheric deposition, the model indicates that all but very large reductions in deposition will further deteriorate catchment water quality. This approach is consistent with currently avaiable observations of water quality, but strict verification of the estimates and model validation is problematic as is the case with all models of long term chemical responses. The model does provide a means of integrating the results of process level laboratory and field studies and can be used as a vehicle for examining the interactions and long-term implications of conceptualization of the acidification process. (Author's abstract)
W87-02271

ASSESSMENT OF LONG-TERM SALINITY CHANGES IN AN IRRIGATED STREAM AQUIFER SYSTEM,
Geological Survey, Reston, VA.
For primary bibliographic entry see Field 5B.
W87-02273

PHASED CELL DIVISION AND GROWTH RATE OF A PLANKTONIC DINOFLAGELLATE, CERATIUM HIRUNDINELLA, IN RELATION TO ENVIRONMENTAL VARIABLES,
Tennessee Univ., Knoxville. Dept. of Ecology.
For primary bibliographic entry see Field 2H.
W87-02311

PEG-MODEL OF SEASONAL SUCCESSION OF PLANKTONIC EVENTS IN FRESH WATERS,
Max-Planck-Inst. fuer Limnologie zu Ploen (Germany, F.R.).
For primary bibliographic entry see Field 2H.
W87-02331

GREEN, BLUEGREEN AND DIATOM ALGAE: TAXONOMIC DIFFERENCES IN COMPETITIVE ABILITY FOR PHOSPHORUS, SILICON AND NITROGEN,
Minnesota Univ., Minneapolis. Dept. of Ecology and Behavioral Biology.
For primary bibliographic entry see Field 2H.
W87-02332

SEASONAL AND AREAL DIFFERENCES IN THE THYROID HISTOLOGY OF THE VENDACE (COREGONUS ALBULA L.) IN FRESH AND BRACKISH WATERS IN FINLAND,
Kuopio Univ. (Finland). Dept. of Applied Zoology.
E. Lahti, and O. V. Lindqvist.
Archiv fuer Hydrobiologie AHYBAY, Vol. 106, No. 4, p 487-496, June 1986. 3 fig, 4 tab, 20 ref.

Descriptors: *Seasonal variation, *Thyroid, *Coregonus albula, *Fish physiology, Brackish waters, Iodine, Water pollution effects, Finland, Bothnian Bay.

Seasonal and regional differences in the histology of the thyroid gland of the vendace (Coregonus albula L.) were investigated in eleven water bodies in different parts of Finland. The thickness of the follicular epithelium reflecting the gland activity was at its greatest in June and its smallest in August. The thickness increased somewhat in autumn and remained unchanged + or - in winter. Regionally there was a significant difference between the northern part of the Bothnian Bay and inland waters; brackish water fish had thicker epithelium than fresh water fish. There was no evident correlation between the thyroid gland histology and the iodine concentration of ambient water. (Author's abstract)
W87-02333

ENZYMATIC DECOMPOSITION OF ORGANIC MATTER BY BACTERIA IN AN EUTROPHIC LAKE,
Warsaw Univ. (Poland). Dept. of Environmental Microbiology.
R. J. Chrost, R. Wcislo, and G. Z. Halemejko.
Archiv fuer Hydrobiologie AHYBAY, Vol. 107, No. 2, p 145-165, August 1986. 7 fig, 58 ref. Ministry of Science, Technology, and High Education, (Poland) Research project MR.II.17.5.1.1.

Descriptors: *Enzymes, *Decomposition, *Limnology, *Organic matter, *Bacteria, *Eutrophic lakes, Decomposing organic matter, Protease, Lipase, Phosphorus, Seasonal variation, Photic zone, Profoundal zone, Phytoplankton.

Annual studies on the temporal and spatial (during spring circulation, winter and summer stagnation) distribution of the total number of heterotrophic bacteria, and the occurrence of protease, amylase, lipase and phosphatase-producing microorganisms in an eutrophic lake, is presented. Exoproteolytic activity (aminopeptidase and endopeptidase) of water samples from the photic zone and profoundal of the lake was also examined. Heterotrophic bacteria in the photic zone showed maximum abundance during the summer stagnation of the lake. However, the first small peak of bacterial population development occurred in spring. Both maxima of the total number of heterotrophic bacteria appeared after the breakdown of phytoplankton blooms. Microheterotrophic populations in the lake were not abundant during late autumn and winter. However, the maximum numbers of heterotrophic bacteria in profoundal occurred in November, after autumn circulation of lake waters. The profoundal bacteria were less abundant than in the photic zone, probably because they were limited by the availability of organic matter. Protease-producing bacteria predominated in lake water during the study period, with amylolytic, lipolytic, lipolytic and phosphatase-producing bacteria showing distinct temporal and spatial distribution patterns. Studies on proteolytic activity (aminopeptidase, endopeptidase) of water samples showed that the enzymatic decomposition rates of proteinaceous material were fastest in the photic zone of the lake. The highest protease activities occurred after the phytoplankton maxima. (Lantz-PTT)
W87-02340

ACUTE LETHAL TOXICITY OF HEAVY METALS TO PERACARID CRUSTACEANS (WITH PARTICULAR REFERENCE TO FRESH-WATER ASELLIDS AND GAMMARIDS),
Nottingham Univ. (England). Dept. of Zoology.
T. R. Martin, and D. M. Holdich.
Water Research WATRAG, Vol. 20, No. 9, p 1137-1147, September 1986. 10 tab, 72 ref.

Descriptors: *Toxicity, *Peracarids, *Water pollution effects, *Lethal limits, *Heavy metals, *Crustaceans, Asellus aquaticus, Crangonyx pseudogracilis, Aluminum, Cadmium, Chromium, Copper, Iron, Mercury, Manganese, Nickel, Lead, Zinc, Silver, Cobalt, Molybdenum, Tin.

In static tests on the acute toxicity of metal salts to two fresh-water peracarids, Asellus aquaticus (L.) (Isopoda) and Crangonyx pseudogracilis Bousfield (Amphipoda), 48 and 96 h LC sub 50 values were determined for Al(III), Cd(II), Cr(III), Cu(II), Fe(III), Hg(II), Mn(II), Ni(II), Pb(II) and Zn(II). Additional metals tested upon Crangonyx alone were Ag(I), Co(II), Cr(VI), Fe(II), Mn(VII), Mo(VI), Sn(II) and V(V). Of the metal salts tested on both species, Asellus was more sensitive to Al(III) and Mn(II) than Crangonyx, similarly sensitive to Cd(II), Fe(III) and Zn(II), and less sensitive to the remainder. Toxicity of metal salts which are unstable with respect to reduction or oxidation was found to be higher than that of the corresponding stable salts of the same metal. Previously published data on the acute toxicity of heavy metal salts to fresh-water, estuarine and marine amphipods and isopods are tabulated and discussed. Brief comparisons are also made between the relative tolerances of peracarids, Daphnia and fresh-water fish. Crangonyx pseudogracilis is recommended as worthy of further research, due to its widespread distribution and ease of culture. (Author's abstract)
W87-02360

FACTORS INFLUENCING THE EFFECT OF BLEACHED KRAFT MILL EFFLUENTS ON DRINKING WATER QUALITY,
Pulp and Paper Research Inst. of Canada, Pointe Claire (Quebec).
T. G. Kovacs, and R. H. Voss.
Water Research WATRAG, Vol. 20, No. 9, p 1185-1191, September 1986. 3 fig, 4 tab, 22 ref.

Descriptors: *Pulp wastes, *Kraft mills, *Drinking water, *Water quality, Bleaching wastes, Odor control, Odors, Biological treatment, Effluents, Water treatment, Chlorine, Taste.

The taste and odor of drinking waters contaminated with bleached kraft mill effluent (BKME) were investigated. Mill effluents with a wide range of odor thresholds were selected and the effects of biological treatment, conventional water purification, carbon filtration, residual chlorine concentration, and recipient water quality were evaluated. The taste and odor of drinking water prepared from pure glacial-fed river water spiked with biotreated BKME from three separate pulp mills was impaired at effluent concentrations ranging from 0.1 to 0.4%. The organoleptic quality of the effluent did not significantly alter the degree of drinking water impairment in this study, as purification of 'downstream' water resulted in similar quality potable water. Effluent biotreatment, conventional water purification, and carbon filtration were beneficial in reducing the taste and odor associated with BKME, but did not entirely eliminate drinking water impairment. The concentration of total residual chlorine in the finished drinking water samples had an important influent on taste, i.e. increased residual chlorine increased the taste of uncontaminated water, but decreased the taste of BKME contaminated water. (Lantz-PTT)
W87-02365

CANCER MORTALITY AND TYPE OF WATER SOURCE: FINDINGS FROM A STUDY IN THE UK,
London School of Hygiene and Tropical Medicine (England).
L. M. Carpenter, and S. A. A. Beresford.
International Journal of Epidemiology, Vol. 15, No. 3, p 312-319, September 1986. 3 fig, 1 tab, 35 ref.

Descriptors: *Cancer, *Mortality, *Water supply, *Statistical analysis, England, Wales, Scotland, Regression analysis, Geographical distribution.

The age-adjusted, sex-specific mortality rates from certain cancers of the digestive system were analyzed by type of water source supplied to 238 urban areas in England, Wales, and Scotland using weighted multiple regression. Of the types of water source, the percent supplied from upland rivers best described the pattern in cancer mortality for each cancer site and each sex. After adjustment was made for a number of socioeconomic factors, the regression coefficient for the percentage of upland river supply remained statistically significant only for female stomach cancer and female intestinal cancer. The association with intestinal cancer could equally well be explained by some other factor with a strong north-west/south-east geographical distribution. The association found for female stomach cancer could not be accounted for by a geographical trend, but suggests a small effect, equivalent to a relative risk of only 1.11. This is an unexpected finding and must be considered an hypothesis, to be tested further by studies conducted by other researchers, in different locations, preferably on individuals. (Author's abstract)
W87-02373

CAMPERS' DIARRHEA OUTBREAK TRACED TO WATER-SEWAGE LINK,
Centers for Disease Control, Atlanta, GA. Epidemiology Program Office.
For primary bibliographic entry see Field 5B.
W87-02388

TOXICITIES OF TOTAL AND CHELEX-LABILE CADMIUM TO SALMON IN SOLUTIONS OF NATURAL WATER AND DILUTED SEWAGE WITH POTENTIALLY DIFFERENT CADMIUM COMPLEXING CAPACITIES,
Seattle Metro Water Quality Lab., WA.
J. A. Buckley, G. A. Yoshida, N. R. Wells, and R. T. Aquino.
Water Research WATRAG, Vol. 19, No. 12, p 1549-1554, December, 1985. 2 fig, 3 tab, 42 ref.

Descriptors: *Toxicity, *Cadmium, *Salmon, *Rivers, *Sewage, *Water pollution effects, *Complexation, Ion exchange, Ion selective electrodes, Adsorption, Resins, Organic compounds, Inorganic compounds.

Factors such as differential complexation, complexing capacity, water quality, total cadmium and Chelex- (an ion exchange resin) labile cadmium were studied to determine how they influence the acute toxicity of cadmium to salmon. Complexing capacity was measured titrimetrically by ISE and the Chelex method. The Chelex-labile fraction of the total Cd concentration was predominatly Cd (2+) and an undetermined amount of Cd(2+) from complexes having a lower stability constant for Cd than Chelex resin under the stated measurement conditions. LC50s were measurabled for both Chelex-labile Cd and total Cd and served as measures of the relative toxicities of Cd in the two waters based on differential complexation and adsorption reactions. The presumed concentrations of Cd(2+) in toxicity test solutions were below ISE detection limits which precluded their measurement as an LC50. (Michael-PTT)
W87-02399

RADON GAS IN GROUND WATER OF NEW HAMPSHIRE,
Minnesota Univ., St. Paul.
For primary bibliographic entry see Field 5B.
W87-02443

REPLACEMENT OF SALT CONTAMINATED WATER SUPPLIES IN BEDROCK AQUIFERS IN MAINE,
Maine Dept. of Transportation, Augusta.
A. C. Olson, M. Allenwood, and J. S. Williams.
IN: The Second Annual Eastern Regional Ground Water Conference, July 16-18, 1985, Portland, Maine. 1985. p 201-211, 4 fig, 1 tab, 1 ref.

Descriptors: *Aquifers, *Maine, *Saline water intrusion, *Groundwater pollution, *Water pollution control, Salinity, Bedrock, Domestic water, Municipal water, Wells, Chlorides.

Contamination of domestic water supplies from uncovered stockpiles of salt or sand-salt is an increasing problem in Maine. When such contamination occurs at state-owned facilities, compensation is provided to affected homeowners. The compensation usually consists of replacing the damaged water supply, but may be provided through cash settlements when this can not be accomplished. Replacement of water supplies can be provided by the installation of municipal water supplies, surface wells (dug or point-driven), or bedrock wells. Replacement with municipal water supplies is the easiest solution, but this option is seldom available in rural Maine. Surface wells are inexpensive and less likely to induce salt contamination than bedrock wells. Contamination plumes in surficial aquifers are easily mapped allowing replacement of the wells in areas unaffected by salt contamination. However, surface wells are perceived as being less desirable than bedrock wells, and are restricted to areas which have sufficient saturated overburden. Delineating contamination plumes in bedrock is difficult. However, noting the locations and salt levels of existing bedrock wells and mapping bedrock fracture orientations improves the ability to install a bedrock well with uncontaminated water. Improvements in the salt storage facilities, especially by housing all salt and sand-salt in enclosed buildings, is the best long-term solution to their problem of groundwater contamination. Unfortunately, this solution does not provide relief in the short term to most homeowners whose wells are contaminated. One bedrock well in Hermon, Maine still had 2900 mg/L chloride 23 years after salt storage was discontinued at an adjacent facility. (See also W87-02437) (Lantz-PTT)
W87-02451

POTENTIAL IMPACTS OF ACIDIC PRECIPITATION ON A SOLE-SOURCE AQUIFER,
New York State Legislative Commission on Water Resources Needs of Long Island, Hauppauge.
For primary bibliographic entry see Field 5B.
W87-02467

EFFECTS OF ACID PRECIPITATION ON GROUND WATER QUALITY IN THE NORTHEASTERN UNITED STATES,
IEP, Inc., Worthington, OH.
D. M. Nielsen, and G. L. Yeates.
IN: The Second Annual Eastern Regional Ground Water Conference, July 16-18, 1985, Portland, Maine. 1985. p 464-479, 5 fig, 1 tab, 36 ref.

Descriptors: *Acid rain, *Groundwater quality, *Water pollution effects, Stress, Soil contamination, Leaching, Heavy metals, Path of pollutants, Drinking water, Lakes, Reservoirs, Aquatic environment.

The phenomenon of acid precipitation detrimentally affects aquatic ecosystems to a presently unknown degree. Some of the environmental consequences of the massive deposition of acid rain which can be quantified on the basis of extensive studies include: (1) deterioration of man-made materials such as statues and monuments, stone facings on buildings, metal structures, and painted surfaces on homes and automobiles; (2) possible reductions in forest productivity, damage to agricultural crops, and increased stress on other vegetative systems; (3) acidification and demineralization of soils and resultant reductions in soil fertility and possibly irreversible changes in soil geochemistry; (4) mobilization and leaching of toxic heavy metals and other cations from soils into ground and surface waters and resultant contamination of drinking water supplies; and (5) acidification of fresh water lakes and reservoirs and resultant damage to fish and other aquatic organisms. Acidification of soils and their resultant demineralization as well as leaching and mobilization of heavy metals are effects which represent direct avenues for potential groundwater contamination. Consequently, these areas are discussed in greater detail with regard to groundwater quality and subsequent impacts on surface waters. (See also W87-02437) (Lantz-PTT)
W87-02468

RESPONSE TO GASOLINE CONTAMINATION OF RESIDENTIAL WATER WELLS - A CASE STUDY,
For primary bibliographic entry see Field 5G.
W87-02470

EVALUATION OF CONTAMINATION BY ORGANICS AND HEAVY METALS IN A SOIL AND BEDROCK AQUIFER,
Goldberg-Zoino and Associates, Inc., Newton Upper Falls, MA.
For primary bibliographic entry see Field 5G.
W87-02473

KESTERSON STORY,
Bureau of Reclamation, Sacramento, CA. Mid-Pacific Regional Office.
S. E. Hoffman, N. J. Williams, and A. I. Herson.
IN: Is Current Technology the Answer, Proceedings of the First Biennial Conference of the National Water Supply Improvement Association, June 8-12, 1986, Washington, DC. (1986). p 77-85.

Descriptors: *Kesterson Reservoir, *Reservoirs, *Selenium, *Water pollution effects, California, Environmental effects, Wildlife, Flow, Drainage, Cost analysis, Water treatment, Public health, Water quality control, Ecological effects, Agriculture.

Kesterson Reservoir was originally constructed as part of an irrigation water drainage system for a portion of the arid San Joaquin Valley of Central

California. Contaminants, principally selenium, present in the drainwater have caused Kesterson Reservoir to become an area of concern because of wildlife impacts. This concern has resulted in discontinuing drainwater flow into Kesterson Reservoir and a major effort by the U.S. Bureau of Reclamation (USBR) to determine accurately the extent of contamination and to develop alternative cleanup plans. These alternatives range from innovative immobilization plans to conventional, but costly, removal and disposal options. Because these problems affect a broad range of both public and private interests, the program has numerous objectives: public health; water quality; fish, wildlife, and their habitats; and agricultural lands and productivity. The problems of contaminated agricultural drainwater are not unique to Kesterson Reservoir and the San Joaquin Valley. Many irrigated areas throughout the Western United States could experience similar problems in the future. (See also W87-02476) (Lantz-PTT)
W87-02480

DISPOSAL OF REVERSE OSMOSIS WATER TREATMENT PLANT REJECT WATER BY INJECTION WELL: AN ASSESSMENT OF GEOCHEMICAL PLUGGING,
Missimer and Associates, Inc., Cape Coral, FL.
For primary bibliographic entry see Field 5E.
W87-02492

POLLUTION POTENTIAL AND REAL ESTATE,
Snell Environmental Group, Inc., Lansing, MI.
M. G. Goergen, and P. F. Cole.
IN: Proceedings of the Fifth National Symposium and Exposition on Aquifer Restoration and Ground Water Monitoring, May 21-24, 1985, The Fawcett Center, Columbus, Ohio. 1985. p 62-68.

Descriptors: *Real estate, *Pollution load, Environmental effects, Path of pollutants, Michigan, Industrial wastes, Soil contamination, Hydrocarbons, Underground storage, Geohydrology, Cost analysis, Aquifers, Groundwater.

When one is considering the purchase of property, it is important to evaluate the pollution potential prior to the purchase. This is particularly important for property which previously was an industrial site or a commercial site. Even if the new owner of the property can avoid liability for the damage from pollution, the discovery of a pollution problem on the property could render the property useless as an investment and/or limit the potential activities on the property. The risk factors include previous use of the property, the geology of the property, the use of the underground aquifer(s), location of the property, status of the previous owner(s) of the property, and the intended use of the property by the new owner. This is demonstrated here by the case study of a Michigan hospital which was interested in purchasing an abandoned industrial site near it to construct a medical office building. The site had been a metal forging factory for over 50 years. The owner had abandoned the site two years before to move the operation to a new facility. The hospital made the purchase of the property contingent upon the findings of an evaluation of the potential of the site. This evaluation included the following: (1) an assessment of the visible condition of the property regarding industrial pollutants; (2) collection of soil samples at three depths over the site (0-6 in, 12 in 24 in deep) and analysis of the samples for oil and grease and the chemicals on the EPA priority pollutant list; (3) collection of floor debris samples in the buildings and analysis of these samples for oil and grease and the chemicals on the EPA priority pollutant list; (4) testing of underground storage tanks for tightness; and (5) hydrogeological evaluation to evaluate the geology of the site and to test the groundwater for contamination originating on the site. The evaluation of pollution potential allowed the hospital to assess these risks in advance of purchasing the property. It also identified increased costs necessary to reduce pollution risks at the site. This information should be obtained by all prudent buyers of property. (See also W87-02437) (Lantz-PTT)
W87-02502

PRIMARY PRODUCTIVITY (C-14) AT TWIN LAKES COLORADO: 1973-81 STUDY RESULTS,
Bureau of Reclamation, Denver, CO. Engineering and Research Center.
For primary bibliographic entry see Field 2H.
W87-02550

PREDICTING AND EVALUATING THE EFFECTS OF ACIDIC PRECIPITATION ON WATER CHEMISTRY AND ENDEMIC FISH POPULATIONS IN THE NORTHEASTERN UNITED STATES,
Columbia National Fisheries Research Lab., MO.
T. A. Haines, S. J. Pauwels, and C. H. Jagoe.
Air Pollution and Acid Rain Report No. 23, Biological Report 80(40.23), April 1986. 139 p, 6 fig, 15 tab, 131 ref, 2 append. Interagency Agreement No. AD-14-F-2A221.

Descriptors: *Acid rain, *Water pollution effects, *Chemical analysis, *Acidic water, *Fish populations, Lakes, Maine, Hydrogen ion concentration, Statistical analysis, Aluminum, Calcium, Trout, Shiners, Sunfish, Suckers, Cadmium, Lead, Mercury, Magnesium, Fish physiology.

This study was conducted to assess the status of fish populations of 22 lakes in Maine representing a range of chemical conditions related to acidity. Of the 22 lakes surveyed, three had pH <5.0 and contained no fish. The remaining 19 lakes had pH 5.4-7.0 and contained 1-10 species of fish. Brook trout, golden shiner, and white sucker were the most common species. White sucker and sunfish (pumpkinseed and redbreast) were ubiquitous with respect to lake pH, but common shiner and creek chub were absent from lakes less than pH 5.9 -6.0. Multivariate statistical analyses showed that the fishless lakes differed from lakes supporting fish primarily with respect to water chemistry variables related to acidity, such as pH, aluminum, and calcium. For lakes containing fish the factors most related to fish species richness and abundance were total ionic strength, maximum depth, and surface area, all measures related to lake productivity, and habitat quantity and diversity. Cluster analysis identified three distinct fish species groups - depauperate, sunfish-sucker, and cyprinid - but multiple comparison analysis failed to relate any measured chemical or physical variable to these groupings. Lakes in the depauperate group tended to be deep and low in ionic strength, and the lack of fish species in these lakes may be the result of low productivity coupled with an absence of extensive littoral areas. Fish from three acidic lakes were higher in whole body residues of cadmium, lead, and mercury than fish from the single circumneutral lake studied. However, stepwise multiple regression analysis indicated that the differences in trace metal content were best explained by the sum of calcium and magnesium or the log of alkalinity of lake water. This suggests that divalent cations play an important role in trace metal uptake. There was no evidence that lake acidity affected whole body stores of sodium or potassium. (Lantz-PTT)
W87-02552

POLLUTION CONTROL AND CONSERVATION,
Ellis Horwood Ltd., Chichester, England, 1985.
Edited by Margit Kovacs. 398 p.

Descriptors: *Water pollution control, *Conservation, Ecological effects, Ecological distribution, Ecosystems, Load distribution, Waterways, Powerplants, Dams, Water quality, Legal aspects, Forests.

This book opens with a detailed account of the components, functions, stability and load capacity of the natural and semi-natural ecosystems vital to life on this planet, as they affect the injurious effects of human interference on the nutrient cycle. There is a prognosis on the effects of planned waterways, power stations and dams upon water quality, and a discussion on the impact of urban development, the role of forests in environmental control, and the interconnection between environmental control and the law. Included is a dictionary of some 600 widely-used abbreviations from international organizations and institutions concerned with this topical subject. (See also W87-02554 thru W87-02560) (Lantz-PTT)
W87-02553

WATER POLLUTION,
J. Ponyi, I. Karpati, and G. Szemes.
IN: Pollution Control and Conservation, Ellis Horwood Ltd., Chichester, England, 1985. p 122-203, 30 fig, 15 tab, 180 ref.

Descriptors: *Water pollution effects, *Water pollution sources, *Lakes, *Rivers, Eutrophication, Phytoplankton, Biomass, Algae, Danube River, Lake Balaton, Hungary, Water pollution control.

Water pollution, in general, is presented with the following headings in this discussion: lake eutrophication; water balance and demands; classification of natural waters, water in the biosphere; process and significance of eutrophication; sources of pollution and water pollution control; algae and macrophytic vegetation of Lake Balaton and their relationship with eutrophication; phytoplankton biomass; primary productivity; hydrobiological study of the Danube; drinking water; bacterial pollution; fisheries; and waterways. (See also W87-02553) (Lantz-PTT)
W87-02556

5D. Waste Treatment Processes

BENTHIC INVERTEBRATE RESPONSE TO POLLUTION ABATEMENT: STRUCTURAL CHANGES AND FUNCTIONAL IMPLICATIONS,
Missouri Cooperative Fishery Research Unit, Columbia.
C. F. Rabeni, S. P. Davies, and K. E. Gibbs.
Water Resources Bulletin WARBAQ, Vol. 21, No. 3, p 489-497, June 1985. 2 fig, 6 tab, 25 ref.

Descriptors: *Benthic fauna, *Water pollution control, *Pulp and paper industry, Biotic index, Penobscot River, Maine, Effluents, Aquatic life.

Changes in certain structural and functional aspects of the benthic invertebrate community in the Penobscot River, Maine, between 1974 and 1981, were examined. During this period, two pulp and paper manufacturers and three municipalities spent an estimated $33 million to reduce point source effluents harmful to aquatic life. A biotic index, based on objectively derived pollution tolerance values for resident taxa, was developed. Analysis of the benthic invertebrate community indicated that substantial improvement in water quality had resulted from pollution abatement. A four-group water quality classification scheme, based on biotic index ranges, showed that every site that was not in the best water quality classification in 1974 improved its classification to a better water quality group in 1981, and that the sites in the best group did not change. Relative abundances of functional feeding groups also changed, as were predicted by the river continuum theory. The effluents acted as a 'reset mechanism' that shifted polluted areas from autotrophic to more heterotrophic conditions. The direction of the shift was reversed in response to abatement efforts. Functional analyses of energy dynamics could lead to a more ecologically sound classification of water quality. The taxa that were measured include: ephemeropters, trichoptera, plecoptera, coleoptera, diptera, odonata, gastropoda, oligochaeta, hirudinea, and crustacea. (Peters-PTT)
W87-01923

COMPARISON OF MUCILAGE POLYSACCHARIDES EXTRACTED FROM SEWAGE ACTIVATED SLUDGE,
Utsunomiya Univ. (Japan). Dept. of Environmental Chemistry.
K. Kakii, S. Kitamura, T. Shirakashi, and M. Kuriyama.
Journal of Fermentation Technology JFTED8, Vol. 64, No. 1, p 51-56, February 1986. 1 fig, 5 tab, 14 ref.

Descriptors: *Mucilage polysaccharides, *Activated sludge, *Wastewater treatment, *Sugars, *Wastewater facilities, Rhamnose, Mannose, Galactose, Aerobic digestion, Sludge.

The sugar compositions of mucilage polysaccharides extracted from activated sludge from five different sewage treatment plants were compared. All the polysaccharides contained rhamnose, fucose, arabinose, xylose, mannose, galactose, glucose, amino sugars, and uronic acids in similar proportions, especially in the neutral sugar fraction. The main components were rhamnose (12-18%), mannose (14-21%), galactose (16-19%), and glucose (15-23%). No significant change was observed in the sugar composition of activated sludge from a sewage treatment plant over a period of more than one year. Recovery of the mucilage polysaccharides fell to 46% of the initial amount when activated sludge was digested aerobically for 10 days, although sugar composition was not affected. (Author's abstract)
W87-01962

ISOLATION AND CHARACTERIZATION OF A CA(++)-DEPENDENT FLOC-FORMING BACTERIUM,
Utsunomiya Univ. (Japan). Dept. of Environmental Chemistry.
K. Kakii, E. Sugahara, T. Shirakashi, and M. Kuriyama.
Journal of Fermentation Technology JFTED8, Vol. 64, No. 1, p 57-62, February 1986. 4 fig, 2 tab, 13 ref.

Descriptors: *Isolation, *Bacteria, *Activated sludge, *Flocculation, *Wastewater treatment, Biological treatment, Enzymes, Sludge, Water treatment, Calcium, Culture media.

When sewage activated sludge was treated with a commercial proteolytic enzyme (Actinase E), 12% of the sludge was deflocculated. However, most of the deflocculated sludge was sedimented by low-speed centrifugation, indicating that only a small part of the sludge was deflocculated to the level of free cells. When bacteria were isolated using the supernatant cell suspension obtained by Actinase treatment and the subsequent low-speed centrifugation, two Actinase E-susceptible floc-forming bacteria were isolated. This study investigated flocculation in a bacterium which showed better growth in Polypepton medium. The bacterium required a slight amount of calcium ion for the flocculation. The cell flocs were completely deflocculated not only by Actinase E, but also by EDTA. Deflocculation also was observed when the flocs were suspended in distilled water. Moreover, the growth rate of the bacterium was not affected by the calcium ion in the culture medium. (Author's abstract)
W87-01963

ANAEROBIC DIGESTION OF RAW STARCH BY BACILLUS SPECIES,
Fermentation Research Inst., Yatabe (Japan).
K. Tadasa, and K. Takeda.
Journal of Fermentation Technology JFTED8, Vol. 64, No. 1, p 81-85, February 1986. 3 fig, 1 tab, 14 ref.

Descriptors: *Bacillus, *Starch, *Anaerobic digestion, *Wastewater treatment, Farm wastes, Fermentation, Anaerobic bacteria, Biodegradation.

Two types of raw-starch-digesting microorganisms were isolated from water and soil and were tentatively identified as Bacillus species. These strains were able to digest potato, corn, and waxy starch in the raw state, producing ethanol, butanol, acetate, butyrate, hydrogen, and carbon dioxide. The main products were ethanol, acetate, and hydrogen gas. The strains were distinguished by the quantities of ethanol and hydrogen gas produced. Amylopectin was digested more vigorously than amylose. Gel permeation chromatography (GPC) spectra showed that a fermentation product with a molecular weight of several thousand daltons was formed in the culture broth, though intermediates of low molecular weight were not detected. This digestion process may be useful for treating wastewater containing agricultural products under anaerobic conditions. (Author's abstract)
W87-01964

ISOLATION AND GROWTH CHARACTERISTICS OF NITRILOTRIACETATE-DEGRADING BACTERIA,
Utsunomiya Univ. (Japan). Dept. of Environmental Chemistry.
K. Kakii, H. Yamaguchi, Y. Iguchi, M. Teshima, and T. Shirakashi.
Journal of Fermentation Technology JFTED8, Vol. 64, No. 2, p 103-108, April 1986. 4 fig, 3 tab, 11 ref.

Descriptors: *Isolation, *Growth, *Nitrilotriacetate, *Bacteria, *Biodegradation, *Wastewater treatment, Biological wastewater treatment, Activated sludge, Degradation, Sludge, Metals.

Two bacterial strains that degrade nitrilotriacetate (NTA) were isolated from NTA-acclimatized activated sludge. These bacteria grew well in NTA medium with optimal pH around 7. The growth rate constants of the bacteria, strains N-2 and N-5, were 0.046/h and 0.11/h at the concentration of 0.1% NTA, respectively. The growth of each bacterium was inhibited at high concentrations of NTA, growth rate decreasing roughly linearly with increasing NTA concentration. Strains N-2 and N-5 showed maximal cell growth at the concentrations of 0.2% and 0.25% NTA, respectively. Strain N-2 would not grow at the concentration of 0.5% NTA, while strain N-5 showed a little growth under the same conditions. Bacterial growth was almost completely inhibited when divalent metal ions such as Mg(++), Ca(++), and Fe(++) were omitted from the culture medium, or slightly excess EDTA (1 mM) was added to the medium. These results suggest that the bacterial growth inhibition at high concentration of NTA is caused by the sequestration of metal ions in the medium. (Author's abstract)
W87-01965

SCP PRODUCTION OF RHODOPSEUDOMONAS SPHAEROIDES ON PINEAPPLE WASTES,
Kasetsart Univ., Bangkok (Thailand). Dept. of Microbiology.
N. Noparatnaraporn, W. Wongkornchawalit, D. Kantachote, and S. Nagai.
Journal of Fermentation Technology JFTED8, Vol. 64, No. 2, p 137-143, April 1986. 6 fig, 2 tab, 17 ref.

Descriptors: *Single-cell proteins, *Wastewater treatment, *Rhodopseudomonas, *Pineapple waste, *Food-processing wastes, Sucrose, Glucose, Fructose, Feeds, Industrial wastes, Bacteria, Photosynthetic bacteria.

Rhodopseudomonas sphaeroides P47, a purple, non-sulfur, photosynthetic bacterium, was isolated from fresh water in the Bangkok area. The organism was selected for single-cell protein (SCP) production from pineapple peel waste (total sugar about 100 g/l) based on its high growth rate, its ability to reduce high chemical oxygen demand (COD) waste from 110.3 to 16.3 g/l (85.3% reduction), and its usefulness as feed supplement due to the high contents of vitamin B12 and photopigments. The pineapple waste solution contained 40.1 g sucrose, 23.6 g glucose, and 14.0 g fructose per liter. A medium was prepared by the addition of (NH4)2HPO4, (NH4)2SO4, nicotinic acid, thiamine-HCl, and biotin. During the cultivation under aerobic, dark conditions, glucose and fructose were preferentially consumed during the inductive stage of sucrose consumption, which was completely used up to the end of cultivation (60 h). The cell mass produced was 26.5 g dry cell/l from 100 g total sugar/l, indicating a growth yield of 0.45 g cell/g sugar consumed. R. sphaeroides P47 might be useful for SCP production from pineapple waste since 2.5 tons dry cell/day would be recovered from 150 tons of peel waste/day discharging from a medium-sized pineapple cannery in Thailand. (Author's abstract)
W87-01966

SLUDGE TREATMENT AND DISPOSAL PROCESSES,
AZS Corp., Atlanta, GA.
For primary bibliographic entry see Field 5E.
W87-02062

SOLIDS INVENTORY CONTROL THROUGH BELT PRESS FILTRATION,
York City Environmental Services Dept., PA.
C. E. Strehl.
Water Pollution Control Association of Pennsylvania Magazine, Vol. 19, No. 3, p 18, May-June 1986.

Descriptors: *Wastewater treatment, *Sludge disposal, *Belt filter press, *Polymer feed system, Incineration, Odors, York, Pennsylvania, Biochemical oxygen demand, Regulations, Wastewater treatment, Wastewater facilities.

The city of York, Pennsylvania, wastewater treatment plant was faced with two problems resulting from disposal of sludge through process of thermal conditioning, vacuum filtration, and incineration: (1) an odor problem that generated numerous complaints and (2) lack of any provision for pretreatment of liquid streams from processing before they were returned to treatment. Because the solids handling system was not continous, the plant was alternately in violation of either 5-day biochemical oxygen demand or suspended solids regulations. The solution to these problems was installation of a 2.5 M belt filter press and associated polymer feed system. (Rochester-PTT)
W87-02063

LEMOYNE, PA - SLUDGE DISPOSAL PRACTICES,
Lemoyne Joint Advanced Waste Treatment Facility, PA.
For primary bibliographic entry see Field 5E.
W87-02064

SLUDGE INCINERATION AT KISKI VALLEY,
Ecoenergetics, Inc., Vacaville, CA.
For primary bibliographic entry see Field 5E.
W87-02065

PERMANGANATE TREATMENT BRINGS ODOR CONTROL SUCCESS,
Carus Chemical Co., La Salle, IL.
R. J. Wilmont.
Water Pollution Control Association of Pennsylvania Magazine, Vol. 19, No. 3, p 24, May-June 1986.

Descriptors: *Wastewater treatment, *Odor control, *Potassium permanganate oxidation, West Virginia, New York, Wastewater facilities.

The Clarksburg, West Virginia, and Albany County, New York, wastewater treatment systems, which are, respectively, 4.6 mgd and 54 mgd (2 plants) experienced problems with process odors. In the Clarksburg case odors were in the surrounding community, generating complaints, whereas in the Albany County case, the concern was odors inside the facilities. In both cases, potassium permanganate oxidation (CAIROX) was employed to solve the problem. A dry-feed approach was used in the West Virginia plant, but in the New York plant an eductor system, purchased from potassium permanganate supplier, was used to prepare a solution. (Rochester-PTT)
W87-02066

COMPOSTING: A SLUDGE MANAGEMENT METHOD GETS UPDATED,
Black and Veatch, Kansas City, MO.
For primary bibliographic entry see Field 5E.
W87-02068

SLUDGE MANAGEMENT PRACTICES IN PHILADELPHIA,
Philadelphia Water Dept., PA. Sludge Management Unit.
For primary bibliographic entry see Field 5E.
W87-02069

LANDFILLING EXPERIENCE AT CITY OF LANCASTER,
Sewage Operations, Lancaster, PA.
For primary bibliographic entry see Field 5E.
W87-02070

INNOVATIVE SLUDGE MANAGEMENT: IMAGINATION AND TECHNOLOGY GO A LONG WAY TO SOLVE A CITY'S SLUDGE PROBLEM,
VFL Technology Corp., Malvern, PA.
For primary bibliographic entry see Field 5E.
W87-02071

RECENT SEWAGE FINANCING IN PENNSYLVANIA,
Collings, Legg, Mason, Inc., Philadelphia, PA.
For primary bibliographic entry see Field 6C.
W87-02072

INTERPRETATION OF ACTIVATED SLUDGE PLANT PERFORMANCE DATA,
Kuwait Univ., Safat. Coll. of Engineering and Petroleum.
M. F. Hamoda, H. A. Al-Rqobah, and S. E. M. Hamam.
Journal of Environmental Science and Health (A) JESEDU, Vol. 21, No. 4, p 333-352, May 1986. 13 fig, 7 ref. Kuwait Univ. Research Council Grant EV.

Descriptors: *Activated sludge process, *Wastewater facilities, *Effluents, *Water quality standards, *Kuwait, *Kinetics, *Model studies, Biological oxygen demand, Chemical oxygen demand, Solids contact process, Aeration, Baffles, Temperature effects.

Data obtained from a Kuwaiti activated activated sludge plant were analyzed using mechanistic models to determine performance characteristics in terms of effluent quality variations and kinetic relationships. It was found that effluent quality expressed in terms of biological oxygen demand and chemical oxygen demand was directly proportional to food-to-microorganisms (F/M) loading and inversely related to solids residence time (SRT). Effluent quality deteriorated as F/M increased or SRT decreased. A 0.4 F/M ratio and five-day SRT produced a biological oxygen demand concentration that met regulatory requirements. Plant performance data is better fitted to a plug-flow kinetic model since baffled-channel type aeration basins are used. The biochemical reaction rate constant increases with temperature and can be interpreted by an Arhenius plot. (Michael-PTT)
W87-02085

THEORETICAL AND HYDRAULIC MODEL STUDY OF A CHLORINE CONTACT TANK,
Birmingham Univ. (England). Dept. of Civil Engineering.
For primary bibliographic entry see Field 5F.
W87-02121

COMPARISON OF TREATMENT METHODS FOR PALM OIL MILL EFFLUENT (POME) WASTES,
Lagos Univ. (Nigeria). Dept. of Chemical Engineering.
J. O. Edewor.
Journal of Chemical Technology and Biotechnology JCTBED, Vol. 36, No. 3, p 212-218, May 1986. 4 tab, 1 ref.

Descriptors: *Palm oil, *Effluents, *Wastewater treatment, *Biological wastewater treatment, *Anaerobic digestion, Nigeria, Chemical oxygen demand, Acidity, Alkalinity, Sludge digestion, Sludge utilization, Economic analysis, Sludge drying.

The efficiency and economic value of several digestion methods used to recover gases and fertilizers from palm oil mill effluent (POME) in Nigeria were evaluated. Several variables such as acidity/alkalinity, decay efficiency of the chemical oxygen demand (COD) contents of POME, economic benefits of digested sludge and biogas and net recovery abilities are reviewed. The COD contents of POME must be reduced to an acceptable level before sludge can be used as fertilizer. COD reduction efficiencies and economic breakeven points for a decanter/drier system, tank digestion, single-stage anaerobic pond and batch pond treatment methods are discussed. It is concluded that the decanter/drier method and tank digester system yield optimal treatment results at relatively low investment costs. (Michael-PTT)
W87-02131

USE OF MONOD KINETICS ON MULTI-STAGE BIOREACTORS,
BASF A.G., Ludwigshafen am Rhein (Germany, F.R.).
A. Braha, and F. Hafner.
Water Research WATRAG, Vol. 19, No. 10, p 1217-1227, 1985. 4 fig, 18 ref.

Descriptors: *Biological treatment, *Wastewater treatment, *Monod kinetics, *Bioreactors, *Activated sludge process, *Biological wastewater treatment, Enzymes, Substrates, Mathematical equations, Mathematical models, Design criteria.

Knowldege of the significance of volume and/or sludge loads gained in decades of operating single-stage activated sludge tanks cannot be readily applied to multi-stage units. This problem is addressed by conducting a process analysis for a series-connection of up to four completely stirred reactors by extending the Monod reaction kinetics model for enzyme-substrate reactions. Graphical solutions are also presented to characterize and design a cascade-connected system. (Michael-PTT)
W87-02149

FACTORS INVOLVED IN THE SETTLEMENT OF ACTIVATED SLUDGE: I. NUTRIENTS AND SURFACE POLYMERS,
Birmingham Univ. (England). Dept. of Civil Engineering.
C. F. Forster.
Water Research WATRAG, Vol. 19, No. 10, p 1259-1264, 1985. 6 fig, 4 tab, 20 ref.

Descriptors: *Activated sludge, *Wastewater treatment, *Sedimentation, *Nutrients, *Polymers, Carbon dioxide, Phosphorus, Aeration, Molecular weight, Interstitial water, Gel filtration.

The settlement characteristics of activated sludge were examined in relation to variations in the main nutrients such as carbon, nitrogen and phosphorus present in sewage being fed to aeration tanks at full-scale plants. Results confirmed previous work which showed that certain combinations of nutrients were more likely to cause poor settlement. The molecular weights of the surface polymers extracted by heat from activated sludge were determined by a gel filtration unit with an exclusion limit of 100,000. This technique found distributions that were similar to those previously reported. The actual weight of the major fraction increased as sludge settlement deteriorated which could be due to steric effects allowing greater amounts of interstitial water to be bound in the sludge. Molecular weight distributions were also determined with a four million exclusion limit gel system which showed the presence of several high molecular weight species, the highest of which exceeded 2,000,000. (See also W87-02156) (Author's abstract)
W87-02155

FACTORS INVOLVED IN THE SETTLEMENT OF ACTIVATED SLUDGE: II. THE BINDING OF POLYVALENT METALS,
Birmingham Univ. (England). Dept. of Civil Engineering.
C. F. Forster.
Water Research WATRAG, Vol. 19, No. 10, p 1265-1271, 1985. 2 fig, 9 tab, 28 ref.

Descriptors: *Activated sludge, *Wastewater treatment, *Sedimentation, *Metal binding, Polymers, Equilibrium, Copper, Zinc, Chromium, Nickel, Molecular structure, Gel filtration.

Extracellular polymers (ECP) were extraced from a series of activated sludges which had settlement properties characterized by SSVI values ranging from 63 to 260. Metal binding properties were examined by gel filtration and equilibrium analysis. Conditional stability constants for the metal/polymer sites, the number of binding sites per molecule of polymer and ECP complexation capacities were quantified. Equilibrium analysis was used to assess the number of binding site types for any metal/polymer series. Gel filtration results showed that the affinity series varied randomly as SSVI varied and that the number of binding sites did not exhibit any particular pattern in relation to settlement. Equilibrium analysis showed that while copper, zinc and chromium behave similarly at all SSVI values, nickel behavior depends on the settlement properties of the sludge. (See also W87-02155) (Author's abstract)
W87-02156

ACETOACETIC ACID AS A POTENTIAL TRIHALOMETHANE PRECURSOR IN THE BIODEGRADATION INTERMEDIATES PRODUCED BY SEWAGE BACTERIA,
Kanagawa Prefectural Public Health Lab., Yokohama (Japan).
S. Itoh, S. Naito, and T. Unemoto.
Water Research WATRAG, Vol. 19, No. 10 p 1305-1309, 1985. 5 fig, 2 tab, 19 ref.

Descriptors: *Acetoacetic acid, *Trihalomethane, *Biodegradation, *Sewage bacteria, Sodium, Glucose, Chloroform, Wastewater treatment, Chlorination.

A high level of chloroform was produced on chlorination during biodegradation when sodium linear dodecylbenzenesulfonate (LAS), sodium dodecylsulfate (AS) and glucose were incubated with sewage bacteria. The primary biodegradation intermediates of LAS and AS were unable to produce a high level of chloroform. Acetoacetic acid produced a large amount of chloroform on chlorination amounting to 55.5% on a molar basis. Formation of acetoacetic acid during biodegradation was determined and it was found that from 51 to 87% of total chloroform produced was derived from acetoacetic acid. These results indicate that acetoacetic acid is a potential chloroform precursor in the biodegradation of organic materials by sewage bacteria. (Author's abstract)
W87-02161

FACTORS AFFECTING THE VERMISTABILIZATION PROCESS: TEMPERATURE, MOISTURE CONTENT AND POLYCULTURE,
New York State Coll. of Agriculture and Life Sciences, Ithaca. Dept. of Agricultural Engineering.
R. C. Loehr, E. F. Neuhauser, and M. R. Malecki.
Water Research WATRAG, Vol. 19, No. 10, p 1311-1317, 1985. 8 fig, 4 tab, 10 ref. NSF Grant No. ISP-8016764.

Descriptors: *Earthworms, *Vermistabilization, *Aerobic conditions, *Biological treatment, *Wastewater treatment, Waste disposal, Organic wastes, Temperature, Sludge digestion.

Several factors, including temperature, moisture content of waste material and polyculture, were evaluated in a study of organic waste stabilization using earthworms (vermistabilization). Several earthworm species were studied. The best growth and reproduction occurred at temperatures between 20 and 25 C. Growth was reduced at 30 C and death occurred at 35 C. Of the species studied, E. fetida produced the largest number of young in a 20-week study. Optimal growth of this species occurred in media with a total solids content, wet basis, of between 9-16%. Polyculture did not appear to have any advantages over monoculture. (Michael-PTT)
W87-02162

METHANOGENIC DEGRADATION OF FOUR PHENOLIC COMPOUNDS,
New York Univ. Medical Center, NY. Inst. of

Environmental Medicine.
L. Y. Young, and M. D. Rivera.
Water Research WATRAG, Vol. 19, No. 10, p 1325-1332, 1985. 2 tab, 6 fig, 38 ref. NIEHS Grant ES00260, EPA Grant R80977010, NSF Grant CEE8118018.

Descriptors: *Methanogenesis, *Microbial degradation, *Phenolic compounds, *Wastewater treatment, Anaerobic digestion, Metabolism, Acetate, Mineralization, Dehydroxylation, Demethylation, Phenol, Phloroglucinol, Hydroquinone, Cresol.

The anaerobic metabolism of phenol, phloroglucinol, hydroquinone and p-cresol under methanogenic conditions was characterized and anaerobic batch studies were conducted with inocula from a municipal sewage treatement plant digester. Substrate concentrations, gas formation and several intermediates formed during degradation were monitored for over a year. Metabolism rates and gas formation generally increased, except for p-cresol, when the microbial community became acclimated to each of the phenolic compounds. Stoichiometric degradation was observed with all four compounds and acetate was present as a methanogenic precursor. Phloroglucinol, hydroquinone and p-cresol were metabolized to phenol before mineralization which indicated that dehydroxylation and demethylation occurs during the initial metabolic phase. Evidence suggests that demethylation is the rate limiting factor for anaerobic p-cresol metabolism. (Author's abstract)
W87-02164

USE OF WOLLASTONITE FOR THE TREATMENT OF CU(II) RICH EFFLUENTS,
Banaras Hindu Univ., Varanasi (India).
K. K. Panday, G. Prasad, and V. N. Singh.
Water, Air, and Soil Pollution WAPLAC, Vol. 27, No. 3/4, p 287-296, 1986.

Descriptors: *Wollastonite, *Copper, Wastewater treatment, Clay, Chemical analysis, Adsorption isotherm, Adsorption dynamics, Desorption, Hydrogen i concentration, Electrokinetics, Langmuir isotherm.

The study of the feasibility of Cu(II) removal by wollastonite, an unconventional adsorbent, is presented. The adsorption technique using wollastonite has been applied for the removal of Cu(II) from aqueous solutions. The low concentration, high temperature and alkaline pH favor the removal of Cu(II). The Langmuir isotherm was used to represent the equilibrium data at different temperatures. The apparent heat of adsorption has been found to be 5.926 Cal per mol. The uptake of Cu(II) is diffusion controlled and the mass transfer coefficient is 0.000036 cm per second. The maximum removal of Cu(II) in alkaline medium has been explained on the basis of the uptake of hydrolyzed adsorbate species by the active surface sites of adsorbent. The results of these investigations are quite useful in developing an appropriate technology for designing a wastewater treatment plant for the removal of Cu(II) and regeneration of wollastonite. This process will be economical and handy. (Main-PTT)
W87-02189

EVALUATING AND UTILIZING BIOKINETIC CONSTANTS IN ACTIVATED SLUDGE,
Virginia Military Inst., Lexington. Dept. of Civil Engineering.
R. O. Mines, Jr., and J. H. Sherrard.
Water, Air, and Soil Pollution WAPLAC, Vol. 27, No. 3/4, p 323-328, 1986. 3 4 ref.

Descriptors: *Biokinetics, *Activated sludge, *Wastewater treatment, Mathematical models, Heterotrophic reactions, Autotrophic reactions, Stoichiometric equations.

The following problem is directed toward practicing design engineers and treatment plant operators to illustrate some of the precautions that must be used when evaluating and utilizing biokinetic constants in biokinetic models. Stoichiometric equations developed from biokinetic equations are presented for evaluating and utilizing biokinetic constants in the design and operation of the activated sludge process. Using biokinetic constants developed from non-nitrifying conditions or total system biokinetic constants rather than individual true biokinetic constants for the heterotrophic and autotrophic reactions will lead to incorrect estimates of the daily waste sludge production. (Main-PTT)
W87-02192

PROTOTHECA (ACHLORIC ALGA) IN WASTEWATER,
West Virginia Univ., Morgantown. Dept. of Microbiology.
R. S. Pore, D. F. Boehm, and E. A. Barnett.
Water, Air, and Soil Pollution WAPLAC, Vol. 27, No. 3/4, p 355-362, 1986. 1 fig, 14 ref.

Descriptors: *Prototheca, *Wastewater treatment, *Anaerobic, Biological film digestion, Effluents, Sludge, Sediments, Flocculation.

In conjunction with the start-up of a secondary wastewater treatment facility, population levels of Prototheca sp. were measured. Wastewater influent levels of the algae were <100 per mL. However, Prototheca sp. trapped in the biological film reached levels $>$ 10,0000 per mL. Effluent levels were only slightly less than influent levels because effluent contained the breaking off film. The film along with the primary sediment retained the high level of Prototheca throughout the 20 day anaerobic digestion; however, growth was not thought to occur. Depending on the method of flocculation, dewatering, and disposal, various levels of Prototheca were returned to the environment in the sludge and effluent. The dynamic change in the Prototheca population levels in the maturing film was thought to reflect the preference for the higher BOD influent. This change was manifest during he fourth month after start-up, as well as when comparing the film at the start with that at the end of the secondary treatment train. (Author's abstract)
W87-02193

EFFECT OF IRON OXIDE REMOVAL ON HEAVY METAL SORPTION BY ACID SUBSOILS,
Delaware Univ., Newark. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 5E.
W87-02194

AMOEBAE IN A WASTE STABILIZATION POND SYSTEM IN MEXICO,
Bulgarian Ecological Society, Svishtov.
F. Rivera, G. Garcia, A. Lugo, E. Zierold, and J. Islas.
Water, Air, and Soil Pollution WAPLAC, Vol. 28, No. 1/2, p 185-198, 1986. 2 fig, 5 tab, 35 ref.

Descriptors: *Amoebae, *Waste stabilization ponds, Pathogens, Free-living amoebae, Alkalinity, Temperature, Wastewater treatment, Mexico.

A protozoological survey was performed to analyze the organisms of the subphylum Sarcodina Schmarda, present in waste stabilization ponds located at Santo Tomas Atzingo, Mexico, from March to December 1981. The amoebae isolated were identified and counted. Several physiochemical parameters (dissolved oxygen, pH, CO2, temperature, acidity, hardness, and alkalinity) were also determined and correlated with the biological data. Thirteen amoebic species were isolated and identified including one pathogentic species (Entamoeba histolytica), three species that have human pathogenic strains, two opportunistic species, and seven free-living species. A clear correlation between the number of amoebae and the temperature and alkalinity of the system was found. The removal capacity of the ponds for E. histolytica varied from 30 to 100% during the survey. The amoebae showed a succession in space and time in the system studied. (Author's abstract)
W87-02205

WATER CYCLE AS A SOURCE OF PATHOGENS,
North West Water Authority, Warrington (England).
For primary bibliographic entry see Field 5B.
W87-02208

BIOLOGICAL TREATMENT OF INDUSTRIAL WASTEWATER: A MICROBIOLOGICAL BASIS FOR PROCESS PERFORMANCE,
Eidgenoessische Anstalt fuer Wasserversorgung, Abwasserreinigung und Gewaesserschultz, Duebendorf (Switzerland).
G. Hamer, T. Egli, and K. Mechsner.
Journal of Applied Bacteriology (Symposium Supplement) JABAA4, p 127S-140S, 1985. 7 fig, 38 ref.

Descriptors: *Wastewater treatment, *Biological treatment, *Industrial wastewater, *Biodegradation, Effluents, Substrates, Carbon, Nitrogen, Nutrients, Microbiological studies, Lysis, Aerobic treatment, Microorganisms.

Biological treatment processes for industrial wastewater are reviewed in relation to the physiological and behavioral characteristics of biotreatment microorganisms. Biotreatment enhancement and inhibiting factors such as temperature, substrate/nutrient availability and fluctuations, co-metabolism and microbial associations and lysis and 'cyrptic' growth in which a species is utilized as a substrate by another species are examined. The importance of microbial associations for the degradation of individual and mixed industrial pollutants is emphasized. (Michael-PTT)
W87-02216

TREATMENT OF WASTES BY ALGAL CULTURE,
West of Scotland Agricultural Coll., Auchincruive. Dept. of Microbiology.
H. J. Fallowfield, and M. K. Garrett.
Journal of Applied Bacteriology (Symposium Supplement) JABAA4, p 187S-205S, 1985. 3 fig, 7 tab, 132 ref.

Descriptors: *Wastewater treatment, *Algae, *Stabilization ponds, Pilot plants, Northern Ireland, Nutrients, Biochemical oxygen demand, Biomass.

Methods of wastewater treatment using algal culture are evaluated and compared. The operations and effectiveness of anaerobic, facultative and maturation waste stabilization and high rate algal ponds (HRAP) are reviewed. Pilot plant experience with an HRAP system in Northern Ireland is described in relation to nutrient and biochemical oxygen demand reduction, biomass production and stability and species composition. Harvesting technology, product composition and rate limiting factors for HRAP technology are also examined. It is concluded that biomass production and pollution control benefits have been significant influences on HRAP technology development and that future development is likely to focus on end-product utilization, refinement of harvesting techniques and further development of mixing strategies to improve process performance. (Michael-PTT)
W87-02219

EVALUATION OF GRAPHITIZED CARBON BLACK CARTRIDGES FOR RAPID ORGANIC TRACE ENRICHMENT FROM WATER: APPLICATION TO PRIORITY POLLUTANT PHENOLS,
Rome Univ. (Italy). Dept. of Chemistry.
For primary bibliographic entry see Field 5A.
W87-02232

USE OF THE UASB REACTOR FOR THE ANAEROBIC TREATMENT OF STILLAGE FROM SUGAR CANE MOLASSES,
Planta Piloto de Procesos Industriales Microbiologicos, Tucuman (Argentina).
F. Sanchez Riera, P. Cordoba, and F. Sineriz.
Biotechnology and Bioengineering BIBIAU, Vol. 27, No. 12, p 1710-1716, December 1985. 5 fig, 3 tab, 20 ref.

Descriptors: *Wastewater treatment, *Anaerobic digestion, *Stillage, *Sugarcane, Argentina, Chemical oxygen demand, Methane, Sludge digestion, Biomass.

The feasibility and advantages of using the UASB packed-bed reactor for anaerobic treatment of stillage from sugarcane distilleries in Argentina are discussed. Results obtained from using a 100-liter UASB reactor treating stillages with chemical oxygen demand (COD) values between 35 and 100 grams COD per liter are presented. Loading rates of up to 24 grams COD per liter per day were applied and resulted in an average COD removal of 75%. Biogas production increased with organic load and average methane content was 58%. Distribution of settling velocities indiciated good formation of biomass pellets. A system interruption of 55 days at ambient temperature was well tolerated. (Michael-PTT)
W87-02237

GRAIN SORGHUM STILLAGE RECYCLING: EFFECT ON ETHANOL YIELD AND STILLAGE QUALITY,
Texas A and M Univ., College Station. Dept. of Agricultural Engineering.
R. P. Egg, J. M. Sweeten, and C. G. Coble.
Biotechnology and Bioengineering BIBIAU, Vol. 27, No. 12, p 1735-1738, December 1985. 5 tab, 4 ref.

Descriptors: *Stillage, *Wastewater treatment, *Water reuse, *Recycling, *Sorghum, *Ethanol, Fermentation, Pilot plants, Chemical oxygen demand, Conductivity, Pollution load.

The effects of recycling different levels of thin stillage from grain sorghum on ethanol yield and stillage characteristics were investigated. Stillage was separated into thin stillage and wet solids fractions. A portion of thin stillage was recycled as cooking water in fermentation runs in bench-scale and pilot plant ethanol production facilities. When thin stillage replaced 50-75% of the cooking water, large increases occurred in solids content, chemical oxygen demand and electrical conductivity. While the volume of thin stillage requiring treatment or disposal decreased, there was no comparable reduction in total pollutant load. Recycling had little effect on the quality of the wet solids fraction. Ethanol yield was reduced after three to five runs at the high levels of stillage recycle used. (Michael-PTT)
W87-02238

DETAILED STUDY OF ANAEROBIC DIGESTION OF SPIRULINA MAXIMA ALGAL BIOMASS,
Laval Univ., Quebec. Dept. de Genie Chimique.
R. Samson, and A. LeDuy.
Biotechnology and Bioengineering BIBIAU, Vol. 28, No. 7, p 1014-1023, July 1986. 3 fig, 6 tab, 32 ref.

Descriptors: *Wastewater treatment, *Anaerobic digestion, *Algae, *Biomass, Ammonia, *Spirulina maxima, Retention time, Volatile acids, Volatile solids, Temperature effects, Methane, Iona, Alkalinity, Hydrogen ion concentration, Nitrogen, Kinetics.

The results of detailed analysis of anaerobic digestion of Spirulina maxima algal biomass are presented. The influence of various combinations of retention times, volatile solids concentrations and temperatures in the range of psychrophilic and thermophilic were investigated. A correlation matrix was used to evaluate the interdependence of parameters such as biogas production and composition, methane production rate and yield, volatile solids reduction, energy efficiency, ionized and nonionized volatile acids, alkalinity, ammonia-nitrogen, pH and electrode potential. Kinetic modeling of data on the inhibitory effects of volatile acids and ammonia on methane generation is also discussed. (Michael-PTT)
W87-02239

INT-DEHYDROGENASE TEST FOR ACTIVATED SLUDGE PROCESS CONTROL,
Florida Univ., Gainesville. Lab. of Environmental Microbiology.
J. M. Lopez, B. Koopman, and G. Bitton.
Biotechnology and Bioengineering BIBIAU, Vol. 28, No. 7, p 1080-1085, July 1986. 7 fig, 1 tab, 39 ref.

Descriptors: *Wastewater treatment, *Dehydrogenase, *Activated sludge, Redox dyes, Oxygen uptake, Toxicity, Hydrogen ion concentration, Chlorine, Sewage bacteria, Industrial wastes, Enzymes, Discharge, Bioindicators.

The effect of process variables on dehydrogenase activity assay of activated sludge using the redox dye 2-(p-iodophenyl)-3-(p-nitrophenyl) -5-phenyltetrazolium chloride (INT) was investigated. INT-dehydrogenase activity (INT-DHA) was directly proportional to INT dosage and inversely proportional to biomass concentration over limited ranges. INT dosages over 2.5mM were toxic to dilute activated sludge suspensions. INT-DHA was greatest near pH 9, while peak oxygen uptake rate (OUR) occurred at pH 8. Both INT-DHA and OUR varied inversely with the age of sludge, but INT-DHA was more sensitive to sludge age. Correlations of INT-DHA and OUR of chlorine stressed activated sludge were found at sludge ages between 2.2 and 7 days. INT-DHA may be an indicator of the toxic shock caused by addition of industrial wastes to municipal systems. Routine monitoring of INT-DHA using sewage bacteria as indicator organisms could be a valuable tool in identifying and controlling toxic discharges. (Michael-PTT)
W87-02240

MIXED CULTURE MODEL OF ANAEROBIC DIGESTION: APPLICATION TO THE EVALUATION OF STARTUP PROCEDURES,
California Inst. of Tech., Pasadena. Dept. of Chemical and Environmental Engineering.
A. Dalla-Torre, and G. Stephanopoulos.
Biotechnology and Bioengineering BIBIAU, Vol. 28, No. 7, p 1106-1118, July 1986. 4 fig, 7 tab, 29 ref.

Descriptors: *Wastewateer treatment, *Anaerobic digestion, *Mathematical models, Microorganisms, Mathematical equations, Hydrolysis, Organic loading, Acetogenesis, Methanogenesis, Prediction, Hydrogen ion concentration, Feed rates, Wastewater disposal.

A mathematical model that describes the interactions among the microbial populations in an anaerobic digester and their effect on digester performance was constructed. The model considers all basic steps of anaerobic digestion, such as organic solids hydrolysis, acetogenesis and methanogenesis, one or more of which may limit or cause the process to fail. Microorganisms were grouped according to functional performance and interactions among populations were analyzed by identifying effects on the abiotic medium. Rate equations and parameter values were obtained from results reported in literature, but since several values were estimated, the model is expected to give only semiquantitative predictions. The model was validated by comparing its predictions to actual digester operation. Several startup procedures such as pH control, intial feed rate and initial distribution were evaluated in relation to model predictions. Improvements in current operational practices are suggested in order to minimize startup time. (Michael-PTT)
W87-02241

SOLID WASTE COMPOSTING GAINS NEW ENERGY,
N. Goldstein.
Biocycle BCYCDK, Vol. 27, No. 7, p 21-25, August 1986.

Descriptors: *Composting, *Waste disposal, *Solid wastes, Rural areas, Marketing, Cost analysis, Contamination, Regulations, Landfills.

The prospects for expanded use of solid waste composting techniques by municipalities are examined. Solid waste composting appears to be a more attractive waste disposal alternative for smaller, rural communities. The viability of large-scale composting systems, technological parameters of composting operations, market potential for solid waste compost and relative costs of composting are reviewed. Barriers to implementation of composting projects include concerns over contamination, marketability of byproducts, regulatory constraints and the existence of substandard landfills. (Michael-PTT)
W87-02242

COMPOSTING PROCESS DESIGN CRITERIA: PART I-FEED CONDITIONING,
R. T. Haug.
Biocycle BCYCDK, Vol. 27, No. 7, p 38-43, August 1986. 8 fig, 2 ref. append.

Descriptors: *Waste disposal, *Composting, *Design criteria, Feed conditioning, Mathematical equations, Energy, Process control, Recycling, Mixing.

The feed conditioning needed to close the energy balance and produce a feed mixture with free air space in a composting system is examined. Structural conditioning processes are evaluated, including conditioning with product recycle, addition of organic amendments and conditioning with energy amendments and product recycle for additional structural conditioning. Design criteria are recommended for determining mixture proportions. (Michael-PTT)
W87-02244

CHEMICAL AND BACTERIOLOGICAL COMPOSITION OF GRANULAR METHANOGENIC SLUDGE,
Agricultural Univ., Wageningen (Netherlands). Dept. of Microbiology.
J. Dolfing, A. Griffioen, A. R. W. van Neerven, and L. P. T. M. Zevenhuizen.
Canadian Journal of Microbiology CJMIAZ, Vol. 31, No. 8, p 744-750, August 1985. 4 fig, 3 tab, 29 ref.

Descriptors: *Methanogenic bacteria, *Wastewater analysis, *Methanogenic sludge, *Sample preparation, Scanning electron microscopy, Drying, Freeze drying, Polymers, Bacterial analysis, Chemical composition, Sedimentation, Sugarcane, Anaerobic digestion, Phenol.

Critical point drying and freeze drying methods for preparing granular type sludge samples from an upflow anaerobic sludge blanket reactor used in processing sugar factory wastewater were compared. Critical point drying permitted observations of extracellular material and intact cells by scanning electron microscopy. The effects of different extraction methods for isolation of extracellular polymers was also investigated. Water-phenol left most of the cells intact and was found to be an efficient extraction method. The high resistance of granules against disintegration by various chemical methods suggested that different extracellular polymers and probably different groups of organisms contributed to the matrix in which the bacteria were embedded. The chemical composition of the granules did not differ from the composition of the bacteria. The buoyant density of the granules indicated that the methanogenic consortia used simple agglomeration to improve their settling characteristics. (Author's abstract)
W87-02255

ALTERNATE SEWERS-NO LONGER ALTERNATE,
For primary bibliographic entry see Field 5G.
W87-02264

CHARACTERIZATION OF DENITRIFYING BACTERIA IN THE VARIOUS COMPARTMENTS OF A BIOLOGICAL SEWAGE PLANT, (CHARAKTERISIERUNG DER DENITRIFIZIERENDEN MIKROFLORA IN DEN VERSCHIEDENEN REINIGUNGSSTUFEN EINER BIOLOGISCHEN KLARANLAGE),

Hohenheim Univ., Stuttgart (Germany, F.R.).
F. Schmider, and J. C. G. Ottow.
Archiv fuer Hydrobiologie AHYBAY, Vol. 106, No. 4, p 497-512, June 1986. 2 fig, 5 tab, 55 ref.

Descriptors: *Wastewater treatment facilities, *Denitrification, *Bacteria, *Classification, Sewage, Acinetobacter, Moraxella, Pseudomonas, Alcagines, Hyphomicrobium, Empedobacter, Aeromonas, Activated sludge, Sedimentation tanks.

Throughout a two year period, various groups of denitrifying bacteria were determined quantitatively in the various compartments of a biological sewage plant (Stuttgart-Busnau) and compared with the denitrifying population of a trickling filter system (Stuttgart-Plieningen). The most abundant strains were isolated, characterized by morphological and physiological properties, and identified. Members of the genus Acinetobacter spp./Moraxella spp. were widely distributed in the influent, whereas prototrophic bacteria of the genus Pseudomonas (P. aeruginosa and P. stutzeri), Alcaligenes denitrificans and Hyphomicrobium spp. constituted the main part of the denitrifying flora in activated sludge. With increasing wastewater purification, the number of prototrophic denitrifying bacteria (Acinetobacter spp., Pseudomonas spp.) diminished while auxotrophic representatives (Aeromonas spp., 'Empedobacter' spp.) increased. Most of the abundant denitrifying bacteria isolated from the denitrification tank, were classified as undescribed species of Aeromonas spp. and 'Empedobacter' spp.. Eighteen non-motile, oxidase-negative, anaerogenic-fermentative, gram-negative rods represent a new group of so far undescribed denitrifying bacteria, and were allocated tentatively as members of 'Empedobacter'. Representatives of these bacteria were characteristics for both the denitrification- and final sedimentation tanks. Pseudomonas aeruginosa, P. stutzeri, Alcaligenes denitrificans and Aeromonas spp. proved to be the most dominant denitrifying organisms in the outflow of a trickling filter. (Author's abstract)
W87-02334

TALE OF THREE GIANT SEWERAGE SYSTEMS,
R. J. Barletta, and R. A. Webber.
Journal - Water Pollution Control Federation JWPFA5, Vol. 58, No. 9, p 871-879, September 1986. 4 fig, 2 tab, 1 ref.

Descriptors: *Wastewater treatment facilities, *California, *Los Angeles, Wastewater treatment, Wastewater renovation, Water reuse, Sewage, Energy, Glendale, Pomona, Jose Creek, Puente Hills.

The city of Los Angeles, the Los Angeles County Sanitation Districts, and the Orange County Sanitation Districts serve a basin area that has experienced some of the fastest growth in the state and the nation over the last 40 years. This has made innovative methods, coalitions, and processes for water reuse an absolute necessity when planning for present and future water use. This heavily populated area is a desert, therefore water supply is critical and wastewater reuse is essential. Energy is a precious commodity and its recovery from treatment processes and products has been given high priority. The purpose of this article is to give an overview of some of the unique sewerage systems of the area, such as the: (1) hyperion energy recovery system of the City of Los Angeles; (2) Terminal Island Treatment Plant; (3) Los Angeles-Glendale Water Reclamation Plant; (4) Donald C. Tillman Water Reclamation Plant; (5) San Jose Creek Water Reclamation Plant; (6) Pomona Water Reclamation Plant; and (7) Puente Hills Landfill. (Lantz-PTT)
W87-02347

VOLATILE ORGANICS IN THE WASTEWATER AND AIRSPACES OF THREE WASTEWATER TREATMENT PLANTS,
Cincinnati Univ., OH.
V. S. Dunovant, C. S. Clark, S. S. Que Hee, V. S. Hertzberg, and J. H. Trapp.
Journal - Water Pollution Control Federation JWPFA5, Vol. 58, No. 9, p 886-895, September 1986. 4 fig, 9 tab, 36 ref. NIEHS-00159.

Descriptors: *Volatile organics, *Wastewater, *Wastewater treatment facilities, Gas chromatography, Industrial wastewater, Air pollution, Chemical analysis, Sewage.

A study of volatile organic compounds in wastewater and airspaces at three wastewater treatment plants was conducted in late summer, 1982. Concentrations of organic vapors responsive to direct-reading flame ionization detection (FID) were highest at the plant with the largest proportion of influent industrial wastewater. The concentrations tended to be highest later in the day, and later in the week at all three plants. Gas chromatographic analysis for 24 priority pollutants in air samples revealed that specific compounds accounted for less than 10% of the total FID-response. There were several correlations of specific compounds in the wastewater with those in the sewer air and of specific compounds in the air with total FID-response at one plant. (Author's abstract)
W87-02348

NITRIFICATION IN TRICKLING FILTERS,
Brown and Caldwell, Walnut Creek, CA.
D. S. Parker, and T. Richards.
Journal - Water Pollution Control Federation JWPFA5, Vol. 58, No. 9, p 896-902, September 1986. 8 fig, 3 tab, 10 ref.

Descriptors: *Nitrification, *Trickling filters, *Wastewater treatment, Biological oxygen demand, Design standards, Organic loading, Heterotrophic bacteria.

Increased interest in trickling filter application in the eighties has led to a need for more complete process design information for cases where simultaneous nitrification and BOD removal is practiced. Data from two pilot studies provided a basis for rationalizing process design relationships. Total organic loading per unit surface area is a more rational design basis than organic loading per unit volume, but it does not fully account for the differences in media types. Because of competition between heterotrophic bacteria and nitrifiers, nitrification is not initiated in the tower until soluble BOD5 concentrations in the liquid film are reduced to 20 mg/L or less. (Author's abstract)
W87-02349

OVERLAND FLOW TREATMENT OF WASTEWATER AT FLORIDA STATE PRISON,
Florida Univ., Gainesville. Dept. of Agricultural Engineering.
A. R. Overman, and D. W. Wolfe.
Journal - Water Pollution Control Federation JWPFA5, Vol. 58, No. 9, p 903-910, September 1986. 17 fig, 7 ref. EPA Contract 12739010.

Descriptors: *Overland flow, *Wastewater treatment, *Florida State Prison, Ammonia, Biological oxygen demand, Performance evaluation, Suspended solids, Algae, Nitrogen, Seasonal variation.

Changes in operation and field management procedures at a 21-ha overland flow system were evaluated for effects on treatment efficiency. Data collected during a 2-year period indicate that performance remains high for continuous applications of up to 2 weeks duration, and is virtually unaffected by winter conditions. Ammonia nitrogen was the limiting constituent when determining maximum application rate. Rapid water movement from the plant to the field reduces algae production, and grass must be harvested and removed on a regular basis for proper field maintenance. Phase-in studies determined the time required for the field to return to steady operating conditions following a rest period. High levels of treatment were achieved within 24 hours for both cool and warm seasons. (Author's abstract)
W87-02350

RATIONAL METHOD FOR SLUDGE DEWATERING VIA FREEZING,
Cold Regions Research and Engineering Lab., Hanover, NH.
S. Reed, J. Bouzoun, and W. Medding.
Journal - Water Pollution Control Federation JWPFA5, Vol. 58, No. 9, p 911-916, September 1986. 4 fig, 3 tab, 10 ref.

Descriptors: *Sludge dewatering, *Freezing, *Wastewater treatment, *Design criteria, Dewatering, Sludge, Cost analysis, Freeze-thaw tests.

An alternative sludge dewatering approach takes advantage of natural energy sources (freeze-thaw) and should be no more difficult to build and operate than a simple uncovered drying bed. Sludge solids are compressed during freezing, which allows the liquid fraction to rapidly drain when it is thawed. Sludges with an undrainable jelly-like consistency will drain immediately and have a 'coffee ground' appearance. The key to practical use of the process is to apply the sludge in relatively thin layers and then wait until each layer has completely frozen before the next is applied. A layer thickness of 8 cm (3 in.) is suitable for most of the northern U.S. and is recommended for preliminary designs. The optimum depth can be determined during final project design. The cost-effectiveness of the process will depend on the area required and land costs, and on the operating costs for multiple winter applications. Odors should not be a problem with digested biological sludges. (Lantz-PTT)
W87-02351

TREATMENT OF THIOSULFATE-CONTAINING WASTEWATER IN ACTIVATED SLUDGE SYSTEMS,
Texas Univ. at Austin. Dept. of Civil Engineering.
E. F. Millano, and C. A. Sorber.
Journal - Water Pollution Control Federation JWPFA5, Vol. 58, No. 9, p 917-923, September 1986. 1 fig, 6 tab, 33 ref.

Descriptors: *Wastewater treatment, *Activated sludge process, *Thiosulfate, *Biological oxidation, Activated sludge, Hydrogen ion concentration, Sulfur, Nitrogen, Phosphorus, Nitrification.

Simultaneous biological oxidation of sodium thiosulfate and organic carbon was studied in continuous bench-scale activated sludge reactors. Thiosulfate oxidation did not influence organic carbon removal, which was more than 90%. Hydraulic detention time, pH, and nitrogen and phosphorus concentrations did not influence elemental sulfur production or the conversion of thiosulfate to sulfate. The thiosulfate food to microorganism ratio was the only determinant parameter. Thiobacillus concentrations were ten thousand bacteria per milliliter of mixed liquor. Nitrification and sludge bulking were not affected. Thiosulfate was chemically stable between pH 4.9 and 9.2 in batch experiments. Because continuous reactor pH was 5.6 to 7.9, thiosulfate removal was assumed to be biologically mediated. (Author's abstract)
W87-02352

ALGAL SEPARATION BY THE LIME-SEAWATER PROCESS,
Florida Univ., Gainesville. Dept. of Environmental Engineering Sciences.
G. M. Ayoub, and B. Koopman.
Journal - Water Pollution Control Federation JWPFA5, Vol. 58, No. 9, p 924-931, September 1986. 9 fig, 2 tab, 23 ref.

Descriptors: *Algal separation, *Wastewater treatment, *Lime-seawater process, *Effluents, *Oxidation ponds, Hydrogen ion concentration, Calcium carbonate, Magnesium hydroxide, Lime, Ions, Algae.

Effectiveness of the lime-seawater process to remove algae from oxidation pond effluents was investigated, and determined to be a technically viable system for upgrading oxidation pond effluents. Algae can be removed with lime as result of the formation and settling of CaCO3 at approximately pH 9.5. Further removal was caused by the formation and settling of Mg(OH)2 at pH 10.2; removal was maximum at approximately pH 11.0. The lime dosage needed to achieve a desired pH

depends largely on the alkalinity and pH of the sample. Other factors that might influence the reaction include the degree of solubility of lime as affected by the feed method and flash mixing speeds. The pH increase caused by the addition of a specific lime dose is reduced by the addition of seawater. The efficiency of algal removal is largely a function of the initial algal concentration, lime dosage (final pH), and seawater concentration. Lime treatment alone can produce relatively acceptable removals where initial algal concentrations are low. However, when initial concentrations are high, lime alone will not produce satisfactory results. The introduction of seawater remarkably improved removals. Seawater addition reduced the required lime dosage for a specific removal at all initial algal concentrations. The effectiveness of seawater is largely a function of the extent of the Mg(OH)2 reaction. In the presence of ample Mg(2+) ions the optimal lime dose required will supply enough OH(-) ions to react with all the Mg(2+) ions present. (Lantz-PTT)
W87-02353

BIOLOGICAL FATE OF ORGANIC PRIORITY POLLUTANTS IN THE AQUATIC ENVIRONMENT,
Pennsylvania Univ., Philadelphia. Dept. of Civil and Urban Engineering.
For primary bibliographic entry see Field 5B.
W87-02354

SPECIFIC DEPOSIT AND MODELS OF HORIZONTAL COUNTER-CURRENT FILTRATION,
Roorkee Univ. (India). Dept. of Civil Engineering.
D. S. Bhargava, and P. K. Pande.
Water Research WATRAG, Vol. 20, No. 9, p 1091-1104, September 1986. 12 fig, 5 tab, 30 ref.

Descriptors: *Filtration, *Wastewater treatment, *Water treatment, *Model studies, *Specific deposits, *Counter-current filtration, *Horizontal filters, Sand filters, Gravel filters, Bentonite clay, Turbidity, Head loss, Mathematical models, Mathematical studies, Filter media.

Horizontal filters with counter-current flow, were studied in the laboratory, under varying discharge conditions with constant head, using sand and gravel as filter media and bentonite clay suspension in water as turbidity. In the coarsest media, incremental head losses were found to increase with time whereas in the finest media, it was found to be reversed. In the intermediate layers, incremental head losses increased at the initial filter run but decreased later on. The increase in specific deposit resulted in incremental head loss whereas decrease in permeability caused a decrease in approach velocity and hence decrease in incremental head loss. Coarsest media layers attract maximum deposits, and leads to more head loss increase as compared to other layers. Exponential decrease in effluent discharge in three distinct stages was observed during the filter run. Specific deposit is maximum in coarsest media, but decreases sharply along the depth of the media. A model is presented to relate depth of media with duration for ac discharge of more than 100 L/min/sq m. It was observed that due to small magnitudes of specific deposit in the sand and gravel media, the exponential constants y and z in the Ives' model of efficiency, are not important. The exponential constant x is however found to play a significant role. Methodology of evaluation of the exponential constant x in Ives' model is presented. This constant x is shown to remain around 1.7. (Lantz-PTT)
W87-02355

WATER PURIFICATION BY FLUIDIZED BED TECHNIQUE,
Benin Univ., Benin City (Nigeria).
C. M. A. Ademoroti.
Water Research WATRAG, Vol. 20, No. 9, p 1105-1109, September 1986. 3 fig, 4 tab, 11 ref.

Descriptors: *Water treatment, *Fluidized bed reactors, *Wastewater treatment, *Nigeria, Alum, Sand filters, Biological oxygen demand, Chemical oxygen demand, Alkyl benzene sulfonate, Coliforms, Suspended solids, Activated carbon, Adsorption.

Composite samples of wastewater obtained from a Nigerian Institution were clarified with a 10% solution of commercial alum and then filtered through a sand bed. The optimum dosage for the clarification was 400 mg/L. Considerable reductions in color, turbidity, suspended solids (SS), biochemical oxygen demand (BOD), chemical oxygen demand (COD), detergents of alkyl benzene sulphonate (ABS) base and total coliform bacteria were achieved in the samples. The samples were further purified by adsorption of their impurities by powered activated carbon (PAC) in a fluidized bed. The purification was done by two models: fluidization with no beads added and fluidization with beads added. With 200 mg/L PAC and fluidization for 10 min, 92.8% COD reduction was achieved with no beads added while 98.5% COD reduction was achieved with 4% (v/v) glass beads added. Fresh surface water samples obtained from a dam were filtered through sand bed and similarly treated with 200 mg/L PAC in the fluidized bed. The qualities of the final effluents obtained from the two types of samples were comparable with the WHO standards for purified water/wastewater meant for recycling purposes. (Author's abstract)
W87-02356

REMOVAL OF CHLORINATED HYDROCARBONS FROM WATER AND WASTEWATER BY BACTERIAL CELLS ADSORBED TO MAGNETITE,
Queensland Univ., Brisbane (Australia). Dept. of Microbiology.
I. C. Mac Rae.
Water Research WATRAG, Vol. 20, No. 9, p 1149-1152, September 1986. 7 fig, 2 tab, 25 ref.

Descriptors: *Chlorinated hydrocarbons, *Water treatment, *Wastewater treatment, *Insecticides, Adsorption, Magnetite, Lindane, Aldrin, Heptachlor, DDT, Hexachlorocyclohexane, Rhodopseudomonas sphaeroides.

The simultaneous removal of six chlorinated hydrocarbons, alpha- and gamma-hexachlorocyclohexane (alpha- and gamma-HCH), dieldrin, heptachlor, aldrin and p, p'-DDT from spiked samples of water and a wastewater, by cells of the bacterium Rhodopseudomonas sphaeroides immobilized on magnetite, was studied. In a contact time of 20 min, levels of heptachlor, aldrin and p,p'-DDT in water were reduced below the level of detection of the electron capture detector and concentrations of alpha-HCH, gamma-HCH and dieldrin were reduced by 29.5, 32.0 and 88.9% respectively. Removal of p,p'-DDT from a spiked wastewater was complete whereas the removals of aldrin, heptachlor, dieldrin, gamma-HCH and alpha-HCH were 92.9, 90.8, 89.9, 30.0 and 32.1% respectively. Sorption of all chlorinated hydrocarbons by the bacterial cells reached equilibrium within 20 minutes. (Author's abstract)
W87-02361

SOLVENT SUBLATION FOR THE REMOVAL OF HYDROPHOBIC CHLORINATED COMPOUNDS FROM AQUEOUS SOLUTIONS,
Arkansas Univ., Fayetteville. Dept. of Chemical Engineering.
K. T. Valsaraj, J. L. Porter, E. K. Liljenfeldt, and C. Springer.
Water Research WATRAG, Vol. 20, No. 9, p 1161-1175, September 1986. 12 fig, 4 tab, 53 ref.

Descriptors: *Solvent sublation, *Chlorinated compounds, *Wastewater treatment, Chlorobenzenes, DDT, Aeration.

Solvent sublation, a surface chemical technique, was used to remove mono-, di-, tri-chlorobenzenes and a chlorinated pesticide (DDT) from aqueous solutions. Considerable improvement in efficiency of removal, as compared to conventional fine bubble aeration, was observed when bubbles of very small size (<0.5 mm dia) were used. The materials were solvent sublated (levitated using fine air bubbles) into mineral oil and lauryl alcohol. The experiments were conducted on a laboratory batch scale. The larger the hydrophobicity of the compound, the better the removal efficiency by solvent sublation was found to be. The removal rate was somewhat enhanced by higher airflow rates and was also more or less independent of the volume of the organic solvent floated on top of the aqueous column. Low aqueous/organic solvent interfacial tension, immiscibility with water and high affinity for the chlorinated compounds were essential characteristics of a good solvent that can be used for sublation purposes. A theoretical model was tested but agreement with experiment was found to be only satisfactory. The effects of non-hydrophobic organics (e.g. ethanol), electrolytes (e.g. sodium nitrate) and long chain alkyl surfactants (e.g. sodium lauryl sulfate) upon the process were also studied. (Author's abstract)
W87-02363

CHROMATE ION-EXCHANGE PROCESS AT ALKALINE PH,
Lehigh Univ., Bethlehem, PA. Dept. of Civil Engineering.
A. K. Sengupta, D. Clifford, and S. Subramonian.
Water Research WATRAG, Vol. 20, No. 9, p 1177-1184, September 1986. 9 fig, 2 tab, 17 ref.

Descriptors: *Chromate, *Ion exchange, *Hydrogen ion concentration, *Wastewater treatment, Alkalinity, Acidity, Resins, Polystyrene, Anions.

Acidic pH operation is universally practiced for the chromate-exchange process due to chromate's very high selectivity over the competing anions at acidic pH. The advantage of such high chromate selectivity is greatly lost due to chromate's early, gradual break-through during column runs, unless a more expensive, multiple-bed, merry-go-round system is employed. Alkaline pH operation has been found to give much sharper chromate breakthrough during column runs, because chromate isotherms are favorable at alkaline pH. However, chromate selectivity is low at alkaline pH with most of the commercially available anion exchange resins. In this study a macroporous, polystyrene matrix resin with a relatively high degree of crosslinking (higher divinylbenzene content) greatly improved chromate selectivity at alkaline pH. Such an increase in selectivity is due to the reduction in the amount of polar water molecules around the ionogenic groups of the new resin. At relatively low sulfate concentrations of competing sulfate ions, alkaline pH operation with the new highly crosslinked polystyrene matrix resin may offer even higher chromate removal capacity, as would be obtained at acidic pH for other commercial anion-exchange resins. This has been demonstrated experimentally using varied sulfate concentrations. (Lantz-PTT)
W87-02364

EFFECTS OF PHOSPHORUS REMOVAL CHEMICALS UPON METHANE PRODUCTION DURING ANAEROBIC SLUDGE DIGESTION,
Alberta Univ., Edmonton. Dept. of Civil Engineering.
W. B. Kindzierski, and S. E. Hrudey.
Canadian Journal of Civil Engineering CJCEB8, Vol. 13, No. 1, p 33-38, February 1986. 6 fig, 5 tab, 17 ref.

Descriptors: *Phosphorus removal, *Methane, *Anaerobic digestion, *Sludge digestion, *Wastewater treatment, Aluminum sulphate, Alum, Ferric chloride, Anaerobic bacteria, Alkalinity, Sludge stabilization, Aluminum, Iron.

Aluminum sulphate (alum) and ferric chloride are commonly employed to aid phosphorus removal in wastewater treatment. Previous studies have indicated that these chemical coagulants produce sludges that adversely affect anaerobic digestion. Methane production in anaerobic digestion, was monitored, and concentrations of aluminum or ion present during batch digestion of chemically precipitated sludges were measured. Both alum and ferric chloride coagulation of activated sludge result in reduced methane generation in batch anaerobic digestion. The effect does not appear to involve any chemical toxic effects on the anaerobic bacteria. Rather, the results indicate that biode-

gradable substrate is rendered less accessible to the bacteria for ultimate conversion to methane. This effect is additional to the adverse effects of reduced sludge alkalinity that have been observed with some full-scale digesters. The reduced methane yields may not be regarded as a serious problem in some cases. However, they also reflect a reduction in sludge stabilization, which may be a concern depending upon the ultimate means of sludge disposal. (Lantz-PTT)
W87-02374

PRESSURE FLOTATION OF ABATTOIR WASTEWATERS USING CARBON DIOXIDE,
Commonwealth Scientific and Industrial Research Organization, Cannon Hill (Australia). Meat Research Lab.
S. M. Travers, and D. A. Lovett.
Water Research WATRAG, Vol. 19, No. 12, p 1479-1482, December, 1985. 2 fig, 4 tab, 19 ref.

Descriptors: *Wastewater treatment, *Meat processing industry, *Pressure flotation, *Flotation, *Carbon dioxide, Nitrogen, Hydrogen ion concentration, Suspended solids, Chemical oxygen demand, Fat, Pretreatment of water, Alum, Acid.

Pressure flotation treatement of abattoir wastewater using carbon dioxide or a one to three mixture of carbon dioxide and nitrogen was evaluated in laboratory tests. The pH decreased when wastewater was not chemically pretreated and removal efficiencies for suspended solids, chemical oxygen demand and fat were no better than for pressure flotation using air. When wastewater was pretreated with alum, removal efficiencies using the carbon dioxide/nitrogen mixture were close to those obtained by dissolved air flotation of wastewater that was chemically pretreated with both acid and alum. (Author's abstract)
W87-02391

HEAVY METAL BINDING TO DIGESTED SLUDGE,
Birmingham Univ. (England). Dept. of Civil Engineering.
K. R. K. Alibhai, I. Mehrotra, and C. F. Forster.
Water Research WATRAG, Vol. 19, No. 12, p 1483-1488, December, 1985. 6 fig, 5 tab, 14 ref.

Descriptors: *Heavy metals, *Digested sludge, *Wastewater treatment, *Metal binding, Anaerobic digestion, Zinc acetate, Lead acetate, Ferrous sulfate, Chromic chloride, Isotherms, Regression analysis, Adsorption.

The interactions of heavy metals with anaerobically digested sludges and digested sludges treated with EDTA were examined by equilibrating with solutions containing zinc acetate, lead acetate, ferrous sulfate and chromic chloride at 20 and 35 C. Langmuir and Freundlich isotherms were used to describe the metal binding characteristics of the solids. Regression analysis was used to obtain the linear part of the isotherm and conditional adsorption constants were calculated from the slope of these lines. Under the study conditions, these calculations indicated that the mechanism of attachment predominantly involved metal/surface ligand interactions. Attachment series based on the various constants are reported and the suitability of using these series to describe the binding of metals relative to one another is questioned. (Author's abstract)
W87-02392

BIOLOGICAL TREATMENT OF CHEMICAL INDUSTRY EFFLUENTS BY STABILIZATION PONDS,
Ben-Gurion Univ. of the Negev, Sde Boker (Israel). Jacob Blaustein Inst. for Desert Research.
A. Abeliovich.
Water Research WATRAG, Vol. 19, No. 12, p 1497-1503, December, 1985. 7 fig, 6 tab, 8 ref.

Descriptors: *Chemical wastewater, *Biological treatment, *Stabilization ponds, *Wastewater treatment, Photosynthesis, Effluents, Chemical oxygen demand, Biological oxygen demand, Irrigation water, Pesticide residues.

A multistage photosynthetic chemostat was fed with chemical industry effluents and operated continuously to test the possibility of treating them by means of stabilization ponds. 70-80% of the chemical oxygen demand (COD) and 80-85% of the biological oxygen demand (BOD) could be removed along with pesticidal activity present in the raw wastewater. Six reactors were required for optimal treatment. Most BOD and COD elimination occurred during a 30-day detention time. These effluents cannot be considered suitable for free discharge, but can be used for irrigation of halotolerant vegetation. (Author's abstract)
W87-02394

ENERGETICS OF SINGLE-SLUDGE NITROGEN REMOVAL,
Technion - Israel Inst. of Tech., Haifa. Faculty of Civil Engineering.
Y. Argaman.
Water Research WATRAG, Vol. 19, No. 12, p 1505-1513, December, 1985. 2 fig, 5 tab, 23 ref.

Descriptors: *Energy use, *Nitrogen removal, *Wastewater treatment, *Sludge, Thermodynamics, Prediction, Microbiological studies, Microorganisms, Mathematical models, Mathematical equations.

Several parameters of a single sludge nitrogen removal system were evaluated in terms of energy use. Experimental results from studies using a synthetic feed were applied to evaluate the proposed method. Based on observed sludge yields, energy use efficiency was estimated at 20 and 40% for heterotrophs and nitrifers, respectively, at a solids residence time ranging from 7 to 17 days. The predicted nitrifers fraction in the sludge was 0.077 at a constant nitrogen/chemical oxygen demand removal ratio of 0.14. This fraction averaged 0.153 based on viable cell counts. The specific nitrification rate was calculated based on total nitrifers mass. Results suggest that a thermodynamic approach can be used to successfully predict several parameters of the single sludge process. Applicability of this method to predict parameters such as nitrifers fraction and specific nitrification rate depends on prior knowledge of energy use efficiency and microbial viability. (Author's abstract)
W87-02395

DISINFECTION OF ADVANCED WASTEWATER TREATMENT EFFLUENT BY CHLORINE, CHLORINE DIOXIDE AND OZONE: EXPERIMENTS USING SEEDED POLIOVIRUS,
Milwaukee Metropolitan Sewerage District, WI. Treatment Services Div.
R. Warriner, K. D. Kostenbader, D. O. Cliver, and W.-C. Ku.
Water Research WATRAG, Vol. 19, No. 12, p 1515-1526, December, 1985. 9 fig, 2 tab, 22 ref.

Descriptors: *Disinfection, *Advanced wastewater treatment, *Wastewater treatment, *Effluents, *Chlorine, *Secondary wastewater treatment, *Chlorine dioxide, *Ozone, *Poliovirus, Suspended solids, Chemical oxygen demand, Nitrogen, Fecal coliform, Bacterial analysis.

Chlorine, chlorine dioxide and ozone were evaluated as chemical disinfectants against seeded poliovirus and natually occurring fecal coliform in wastewater effluent that had received secondary treatment followed by bench scale advanced wastewater treatment (AWT) consisting of lime or alum treatment followed by mixed media filtration. This effluent had low concentrations of suspended solids, but chemical oxygen demand and nitrogen concentrations were only slightly lower than those of secondary effluent. Lime treatment reduced virus numbers more than alum treatment, but there was no similar reduction in fecal coliform organisms. Doses of chlorine and chlorine dioxide similar to those required to disinfect secondary effluent were needed to reduce seeded poliovirus to less than detectable limits in the AWT effluent. The required contact times were also comparable. Ozone dose levels at which poliovirus was reduced were ineffective against fecal coliform, which required higher doses for reduction to less than detectable limits. Fecal coliform may be an effective indicator for ozone disinfection because they were more resistant to ozone than seeded poliovirus. (Author's abstract)
W87-02396

CHEMICAL REGENERATION OF EXHAUSTED ACTIVATED CARBON-II,
Birmingham Univ. (England). Dept. of Civil Engineering.
R. J. Martin, and W. J. Ng.
Water Research WATRAG, Vol. 19, No. 12, p 1527-1535, December, 1985. 3 fig, 7 tab, 15 ref, 2 append.

Descriptors: *Activated carbon, *Regeneration, Phenols, Molecular weight, Adsorption, Organic solvents, Organic compounds, Chemical properties, Organic solvents.

A range of organic and inorganic regenerants was evaluated for the treatment of carbon samples exhausted with 2-naphthol, 2-methoxyphenol, 2-chlorophenol, o-cresol and 2-nitrophenol to compare the effects of introducing a second benzene ring, OCH3, Cl, CH3, and NO2 groups to phenol on susceptibility to desorption. There was a correlation between decreasing molecular weight of adsorbate and decreasing value of regeneration efficiency. The smaller the adsorbate, the further it could penetrate into the micropores of the carbon thereby resisting displacement by the regenerant. It was also observed that the smaller the organic regenerant, the further it could penetrate into the micropores of the carbon and displace the adsorbate. These complementary observations indicate that where chemical reactions are unlikely between organic regenerant and adsorbate, the regeneration process is governed by physical displacement of the adsorbate molecule by the organic solvent molecule. This confirms the importance of molecular weights and sizes of both the adsorbate and the solvent. (Author's abstract)
W87-02397

PREDICTION OF MULTICOMPONENT ADSORPTION EQUILIBRIA IN BACKGROUND MIXTURES OF UNKNOWN COMPOSITION,
Michigan Technological Univ., Houghton. Dept. of Civil Engineering.
J. C. Crittenden, P. Luft, and D. W. Hand.
Water Research WATRAG, Vol. 19, No. 12, p 1537-1548, December, 1985. 13 fig, 5 tab, 21 ref. NSF Grant CEE-8300213, EPA Cooperative Agreement CR811150-01-0.

Descriptors: *Adsorption, *Wastewater treatment, *Water treatment, *Prediction, *Equilibrium, Isotherms, Tracers, Organic compounds, Activated carbon, Groundwater pollution, Mathematical models, Mathematical equations, Contamination.

A technique was developed to predict adsorption equilibria of known organic solutes onto granular activated carbon in mixtures of unknown composition. Ideal adsorbed solution theory (IAST) described the competitive interaction between adsorbates. Theoretical components were used in IAST calculations to account for the competitive effects of the unknown mixture. Theoretical component isotherm parameters and concentrations were determined by conducting a multicomponent isotherm of a tracer component which was added to the unknown mixture or singled out from it. Once these parameters were determined, identical parameters were used to predict competitive interactions between any known component and the unknown mixture. This procedure was experimentally verified using two activated carbons, three synthetic mixtures and a contaminated groundwater. The organic solutes were a halogenated one and two carbon aliphatics which are common groundwater contaminants. (Author's abstract)
W87-02398

INFLUENCE OF BACTERIAL GROWTH IN GRANULAR ACTIVATED CARBON FILTERS ON THE REMOVAL OF BIODEGRADABLE AND OF NON-BIODEGRADABLE ORGANIC

COMPOUNDS, (INFLUENCE DU DEVELOPPEMENT BACTERIEN AU SEIN DES FILTRES DE CHARBON ACTIF EN GRAINS SUR L'ELIMINATION DE COMPOSES ORGANIQUES BIODEGRADABLES ET NON BIODEGRADABLES),
Poitiers Univ. (France). Lab. de Chimie de l'Eau et des Nuisances.
J. De Laat, F. Bouanga, M. Dore, and J. Mallevialle.
Water Research WATRAG, Vol. 19, No. 12, p 1565-1578, December, 1985. 14 fig, 8 tab, 27 ref.

Descriptors: *Bacterial analysis, *Activated carbon, *Carbon filters, *Wastewater treatment, *Biodegradation, *Organic compounds, Adsorption, Filtration Organic matter, Regeneration, Oxygen requirements, Solutes, Kinetics.

The effect of bacterial activity in granular activated carbon filters on removal of biodegradable and nonbiodegradable organic compounds was studied in a two-part series of experiments with one-solute and bisolute solutions of organic compounds. In the first part, adsorption capacities and kinetics were determined from batch experiments and the influence of competitive adsorption on the breakthrough curves was shown by means of dynamic tests. In the second part, filtrations of a mixture of biodegradable and nonbiodegradable compounds were conducted to study the influence of biodegradation on removal of organic matter. Four aromatic compounds were tested. Single-solute isotherms agreed with the Freundlich isotherm. Adsorption capacities obtained with bisolute solutions depended on the relative concentration of each compound because of competitive adsorption. Capacities calculated from filtration experiments agreed with those from batch tests. Results of filtration tests showed that removal of organic matter is obtained by adsorption during the bacteria's acclimitization period which depends on the nature of the substrate. After the start of biodegradation, bacterial activity eliminated biodegradable solutes present in the influent and caused partial microbiological regeneration of the carbon. Comparison of breakthrough curves indicated that biodegradation of salicylic acid and 4-nitro-phenol leads to increased adsorption capacity of activated carbon for nonbiodegradable solutes. Granular carbon acts mainly as a support for bacterial fixation and growth in cases of biodegradable compounds. (Michael-PTT)
W87-02401

UPTAKE AND RELEASE OF PHOSPHATE BY A PURE CULTURE OF ACINETOBACTER CALCOACETICUS,
H. Ohtake, K. Takahashi, Y. Tsuzuki, and K. Toda.
Water Research WATRAG, Vol. 19, No. 12, p 1587-1594, December, 1985. 8 fig, 3 tab, 24 ref.

Descriptors: *Phosphates, *Phosphorus removal, *Wastewater treatment, *Adsorption, *Biological wastewater treatment, *Biological phosphorus removal, Bacteria, Bacterial analysis, Acetate, Aerobic conditions, Anaerobic conditions.

Uptake and release of phosphorus by a pure culture of Acinetobacter calcoaceticus were investigated under aerobic and anaerobic conditions. The total phosphorus content of the bacterium varied under the various culture conditions. Nuclear magnetic resonance spectra indicated that a portion of the polyphosphates was likely to be bonded to some sort of structural components of the cell. This bacterium releases phosphate linearly with time when transferred from aerobic to anaerobic conditions. About 4-8% of the phosphorus was released within the first six hours. Acetate was not taken up during the process of phosphorus release. (Michael-PTT)
W87-02403

SAND/GRANULAR CARBON FILTRATION TREATMENT SYSTEM FOR REMOVING AQUEOUS PESTICIDE RESIDUES FROM A MARINE TOXICOLOGY LABORATORY EFFLUENT,
Environmental Research Lab., Gulf Breeze, FL.
J. C. Moore, D. J. Hansen, R. L. Garnas, and L. R. Goodman.
Water Research WATRAG, Vol. 19, No. 12, p 1601-1604, December, 1985. 1 fig, 2 tab, 2 ref.

Descriptors: *Carbon filters, *Pesticide residues, *Marine animals, *Sand filters, *Effluents, *Wastewater treatment, Organophosphorus compounds, Suspended solids, Percolating filters.

Large volumes of contaminated seawater effluent which require treatment before their release to the environment are generated during flow-through toxicity tests using marine organisms. A sand filtration/carbon treatment system that removes organophosphate and pyrethroid pesticide residues to their detection limit was developed. The sand filter removed an average of 72% of the chemicals through continuous filtration of suspended particles and associated chemicals. Effluent water is slowly percolated through granulated carbon following filtration. Organic removal averages 91% and initial construction cost is less than $20,000. (Michael-PTT)
W87-02405

ACTIVATED SLUDGE RESPIROMETRIC MEASUREMENTS,
United Nations Development Programme, Maputo (Mozambique).
J. Suschka, and E. Ferreira.
Water Research WATRAG, Vol. 20, No. 2, p 137-144, February, 1986. 11 fig, 2 tab, 10 ref.

Descriptors: *Activated sludge, *Respiration, *Measurements, Substrates, Kinetics, Oxidation, Oxygen requirements, Biological oxygen demand, Biomass.

Respirometric measurements of activated sludge can be a valuable source of information about the kinetics of substrate bio-oxidation. Two new techniques are elaborated which use an oxygen probe to determine different rates of oxygen consumption. The biological oxygen demand of a given substrate can be determined based on short period oxygen consumption measurements. These techniques have shown consistency in both evaluation of oxygen consumption rates as an operational parameter at a sludge treatment plant and in determination of the substrate biological oxygen demand rate. Respirometric measurement can also be used to evaluate the biomass yield coefficient. (Author's abstract)
W87-02407

COMPARISON OF POSITIVELY CHARGED MEMBRANE FILTERS AND THEIR USE IN CONCENTRATING BACTERIOPHAGES IN WATER,
Florida Univ., Gainesville. Dept. of Microbiology and Cell Science.
For primary bibliographic entry see Field 5A.
W87-02408

NITROGEN REMOVAL IN A SEMI-CONTINUOUS PROCESS,
Technion - Israel Inst. of Tech., Haifa. Faculty of Civil Engineering.
Y. Argaman.
Water Research WATRAG, Vol. 20, No. 2, p 173-183, February, 1986. 7 fig, 2 tab, 9 ref, append.

Descriptors: *Wastewater treatment, *Nitrogen removal, Ammonia, Nitrification, Aeration, Denitrification, Decantation, Hydraulics.

Nitrogen removal capabilities of the continuously fed intermittently decanted process were evaluated in laboratory tests using synthetic feed. Experimental results were in general agreement with predicted values. Ammonia removal was governed by the extent of nitrification during aeration and the level of leakage during settling and decantation Ammonia removal is controlled by aerobic solids residence time and ammonia leakage is controlled by hydraulic parameters. A short cycle, short settling and short decantation times are conducive to low leakage for a given nominal hydraulic residence time. Total nitrogen removal can be obtained if a well nitrifying system is allowed to denitrify. Denitrification is primarily affected by the anoxic fraction of the cycle. The specific denitrification rate is comparable to reported values for internal or endogenous denitrification in conventional systems. (Author's abstract)
W87-02411

OZONATION OF NAPHTHALENE IN AQUEOUS SOLUTION-I. OZONE CONSUMPTION AND OZONATION PRODUCTS (OZONATION DU NAPHTALENE EN MILIEU AQUEUX-I. CONSOMMATION D'OZONE ET PRODUITS DE REACTION,
Poitiers Univ. (France). Lab. de Chimie de l'Eau et des Nuisances.
B. Legube, S. Guyon, H. Sugimitsu, and M. Dore.
Water Research WATRAG, Vol. 20, No. 2, p 197-208, February, 1986. 11 fig, 7 tab, 20 ref.

Descriptors: *Ozonation, *Wastewater treatment, *Water treatment, *Naphthalene, Ozone, Organic carbon, Gas chromatography, Mass spectrometry, Oxidation, Chemical reactions, Polyaromatic compounds, Byproducts.

Ozonation of naphthalene was studied in a dilute aqueous medium to determine ozone consumption and quantify and identify ozonation byproducts. Ozonation was conducted in a bubble column reactor and HPLC analysis of naphthalene and ozonation byproducts was performed. Analyzed products represented only 30% of the initially introduced organic carbon. Separation and identification of ozonation byproducts from a more concentrated naphthalene solution in an H2O/CH3OH mixture was performed and the extract was analyzed using gas chromatorgraphy/mass spectrometry. Based on the identified oxidation products and data found in literature, three reaction pathways for the initial attack of ozone on naphthalene are proposed. A kinetic study will provide further information on the initial ozone attack on naphthalene. (See also W87-02414) (Michael-PTT)
W87-02413

OZONATION OF NAPHTHALENE IN AQUEOUS SOLUTION-II. KINETIC STUDIES OF THE INITIAL REACTION STEP, (OZONATION DU NAPHTALENE EN MILIEU AQUEUX - II. ETUDES CINETIQUES DE LA PHASE INITIALE DE LA REACTION),
Poitiers Univ. (France). Lab. de Chimie de l'Eau et des Nuisances.
B. Legube, H. Sugimitsu, S. Guyon, and M. Dore.
Water Research WATRAG, Vol. 20, No. 2, p 209-214, February, 1986. 5 fig, 3 tab, 6 ref.

Descriptors: *Ozonation, *Naphthalene, *Kinetics, Water treatment, Wastewater treatment, Hydrogen ion concentration, Stoichiometry, Chemical reactions, Neutralization, Prediction.

A kinetic study of naphthalene ozonation was conducted to specify the pathway of the initial ozonation step based on three reaction pathways previously identified. This study was performed at pH 5.6 at 1 C in a batch reactor and initial concentrations were selected so that the opening of a second aromatic ring of naphthalene would not be significant. The results of analysis of ozone and naphthalene consumed showed that the stoichiometry of the initial reaction step was two mol of ozone by mol of naphthalene and a two-order kinetic law was verified for a lengthy period at different initial concentrations. These data exclude both the hypothesis of electrophilic substitution and the hypothesis of two simultaneous dipolar cycloadditions. The same experiments performed at pH 4.3 and 6.8 showed a low increase of the kinetic constant between pH 4.3 and 5.6. Kinetic constant increase at pH 6.8 was probably due to ozone decomposition in water at neutral pH. A kinetic study at different temperatures allowed determination of the value of activation energy. The rate constant value at 20 C and pH 5.6 is practically the same as the value mentioned by Hoigne when the reaction is carried out at 20 C with pH 2 in the presence of radical scavengers. The rate constant values of 1-chloro naphthalene and 2-methyl naphthalene permitted prediction that the initial attack

of ozone on 1,2 bond of naphthalene is electrophilic. (Michael-PTT)
W87-02414

DEEP BED FILTRATION: A NEW LOOK AT THE BASIC EQUATIONS,
Dundee Univ. (Scotland). Dept. of Civil Engineering.
R. M. W. Horner, R. J. Jarvis, and R. I. Mackie.
Water Research WATRAG, Vol. 20, No. 2, p 215-220, February, 1986. 2 tab, 13 ref, 2 append.

Descriptors: *Wastewater treatment, *Water treatment, *Filters, *Filtration, *Mathematical equations, Deep percolation, Mathematical models, Differential equations, Kinetics, Filteres, Approximation method.

Mathematical models of deep bed granular filters are ususally based on an equation of mass balance and a commonly used equation to express the kinetics of the process. This combination of equations leads to an inconsistency which has not been resolved either by attempting to express the equations in filter rather than absolute time or by assuming the offending terms are negligible. This inconsistency does not arise when a new, rational kinetic equation is combined with the more complicated form of the mass balance equation. These equations are awkward to solve, so there is an incentive to use simplified approximations which offer the possibility of exact solution. Comparing series solutions for the simple and precise equations indicates that accuracy is not lost in using the approximations. It is also concluded that the concept of filter time does not simplify the mathematics. (Author's abstract)
W87-02415

INVESTIGATIONS INTO THE SCOPE AND LIMITATIONS OF THE BISMUTH ACTIVE SUBSTANCES PROCEDURE (WICKBOLD) FOR THE DETERMINATION OF NONIONIC SURFACTANTS IN ENVIRONMENTAL SAMPLES,
Unilever Research Port Sunlight Lab. (England).
For primary bibliographic entry see Field 5A.
W87-02419

WASTE WATER PURIFICATION. (ABWASSER-REINIGUNG),
BASF A.G., Ludwigshafen am Rhein (Germany, F.R.).
H. H. Daucher.
Chemie Ingenieur Technik CITEAH, Vol. 57, No. 11, p 963-964, November 1985. 4 fig.

Descriptors: *Wastewater treatment, *Wastewater renovation, *Industrial wastes, Metals, Chlorinated hydrocarbons, Biological wastewater treatment, Phenols, Ketones, Precious metals.

The wastewater treatment technology displayed at the ACHEMA 85 industrial fair is reviewed. The technologies described include newly developed methods and instrumentation for biopurification, for the removal of inorganic salts and acids, dissolved chlorinated hydrocarbons, phenols, or ketones, for the regeneration of HCl and H2SO4, and for the reclamation of metals, especially precious metals. (Airone-PTT)
W87-02428

CHEMICAL AND BIOCHEMICAL OXYGEN DEMAND (COD,BOD) AS KEY PARAMETERS FOR THE SUMMARIZING ASSESSMENT OF ORGANIC WATER CONTAMINANTS, (CHEMISCHER UND BIOCHEMISCHER SAUERSTOFFBEDARF (CSB,BSB) ALS SCHLUESSELPARAMETER FUER DIE SUMMARISCHE BEURTEILUNG ORGANISCHER WASSERBELASTUNGSSTOFFE),
Stuttgart Univ. (Germany, F.R.). Inst. fuer Siedlungswasserbau, Wasserguete- und Abfallwirtschaft.
For primary bibliographic entry see Field 5A.
W87-02434

IS CURRENT TECHNOLOGY THE ANSWER.
National Water Supply Improvement Association, Springfield, VA.
For primary bibliographic entry see Field 5G.
W87-02476

LATEST APPLICATIONS OF MEMBRANE SEPARATION TECHNOLOGIES TO INDUSTRIAL EFFLUENT TREATMENT,
C3 International, Minneapolis, MN.
P. S. Cartwright, and K. T. Finkenbiner.
IN: Is Current Technology the Answer, Proceedings of the First Biennial Conference of the National Water Supply Improvement Association, June 8-12, 1986, Washington, DC. (1986). p 138-159, 8 fig.

Descriptors: *Membrane processes, *Separation techniques, *Industrial wastewater, *Effluents, *Wastewater treatment, Reverse osmosis, Ultrafiltration, Microfiltration.

With regard to the future, certainly with increased emphasis on resource recovery and enforcement of the Resource Conservation and Recovery Act, and other similar legislation, the use of membrane technology will increase markedly as its contributions to effluent treatment become more universally understood and publicized. The membrane separation technologies addressed in this paper include: microfiltration, ultrafiltration, and reverse osmosis. Although they all provide separation of liquid borne contaminants from the liquid, each utilizes a different separation mechanism and has specific advantages and disadvantages when compared to the others in a particular application. There are a number of waste treatment and processing applications awaiting the development of a true ultrafiltration membrane (no salts rejection) with a molecular weight cut-off in the range of 500-1000 daltons. (See also W87-02476) (Lantz-PTT)
W87-02483

USE OF MULTIEFFECT VAPOR-COMPRESSION DISTILLATION TO REDUCE WATER COST AND ENERGY CONSUMPTION IN THE REDUCTION OF CONCENTRATED WASTE STREAMS VOLUME FROM WATER RECOVERY INSTALLATIONS,
California Univ., Richmond. Water Thermal and Chemical Technology Center.
B. W. Tleimat.
IN: Is Current Technology the Answer, Proceedings of the First Biennial Conference of the National Water Supply Improvement Association, June 8-12, 1986, Washington, DC. (1986). p 210-251, 12 fig, 5 tab, 10 ref.

Descriptors: *Vapor-compression distillation, *Water costs, *Waste streams, *Wastewater renovation, Distillation, Wastewater treatment, Cost analysis, Evaporators, Energy.

Single-effect vapor-compression (SEVC) distillation is the predominant method presently in use to reduce the volume of waste streams from water recovery plants at inland locations. Since multieffect vapor-compression (MEVC) distillation is thermodynamically more energy efficient than SEVC, then the use of MEVC instead of SEVC to reduce the volume of waste streams should result in lower energy consumption and as a consequence should also result in lower water cost. A wiped-film rotating-disk evaporator can desalt agricultural drainage water softened by ion exchange without scale and produce distilled water of very high quality (2 ppm TDS) and brines with TDS of 140,000 ppm or higher. Energy consumption by the compressor, depends on brine TDS for the same product rate per unit area of heat-transfer surface. The use of multiple-effect vapor-compression using conventional tubular evaporators to desalt saline water reduces energy consumption by the compressor as well as reducing. The use of evaporators with high values of U/C (heat-transfer capacity per unit of money) will result in lower distilled water cost by reducing energy consumption and lowering the cost of the evaporator. The combined use of evaporators with high values of U/C and multiple-effect vapor-compression will reduce distilled water cost by reducing energy consumption, and evaporator cost as compared to single-effect vapor-compression using an evaporator with a low value of U/C. (See also W87-02476) (Lantz-PTT)
W87-02486

UNDERSTANDING WATER CHEMISTRY: THE NEED FOR IMPROVED ANALYSES IN REVERSE OSMOSIS PLANT OPERATIONS,
Goodrich (B.F.) Co., Beltsville, MD. Specialty Polymers and Chemicals Div.
W. Himelstein, and J. Goochee.
IN: Is Current Technology the Answer, Proceedings of the First Biennial Conference of the National Water Supply Improvement Association, June 8-12, 1986, Washington, DC. (1986). p 334-344, 4 tab, 2 ref.

Descriptors: *Water analysis, *Chemical analysis, *Reverse osmosis, *Water treatment, Water treatment facilities, Sample preparation, Fouling, Scaling, Cost analysis, Membranes.

Methods are reviewed for proper sample handling techniques for reverse osmosis (RO) sample analysis, and the benefits of performing these analyses. It is important to understand that many types of fouling and scaling can be prevented. The key to preventing trouble is early detection and rapid diagnosis using routine water and filter analysis performed by a laboratory experienced in RO applications. This will alert the system operator to respond quickly with the appropriate chemical cleaners in the event of a performance decline. Analytical chemistry can bridge the gap between RO technology and operational success, helping the RO industry gain wider acceptance as the technology of choice for water users. As the success and longevity of RO is seen in various applications, its usage will grown, expanding the whole market. A proper analytical testing program can help in achieving this goal. Choosing an analytical service laboratory that has understanding of complex water chemistries in relation to RO_2 as well as a practical working knowledge of RO systems, enables diagnosis of the most difficult problems and provides the operator with assistance in solving those problems. The cost of routine analytical testing is far outweighed by the cost of downtime, ineffective cleaning of the membrane and membrane replacement. (See also W87-02476) (Lantz-PTT)
W87-02491

5E. Ultimate Disposal Of Wastes

ALGAL BIOASSAY AND GROSS PRODUCTIVITY EXPERIMENTS USING SEWAGE EFFLUENT IN A MICHIGAN WETLAND,
Duke Univ., Durham, NC. School of Forestry and Environmental Studies.
For primary bibliographic entry see Field 5C.
W87-01894

SODICITY LEVELS OF SOILS EQUILIBRATED WITH WASTEWATERS,
Agricultural Research Organization, Bet-Dagan (Israel). Volcani Center.
R. Levy, P. Fine, and A. Feigin.
Soil Science Society of America Journal SSSJD4, Vol. 50, No. 1, p 35-39, January-February 1986. 2 fig, 7 tab, 23 ref.

Descriptors: *Ammonium ion, *Potassium, *Sodium, *Sodicity, *Liquid sludge, *Secondary sewage, *Carbonate precipitation, Wastewaters.

To determine the effect of NH4(+), K, and Na exchange reactions concurrent with carbonate precipitation on the sodicity levels of soil effluents, samples of sandy, loessial, and clay soils were treated with two wastewaters, a secondary sewage and a liquid sludge. More CaCO3 precipitated following the liquid sludge treatment than after the secondary sewage treatment. However, the sodicity levels of the liquid sludge leachates of the three soils were almost unchanged, as compared with that of the wastewater, whereas those of the secondary sewage increased slightly. This difference presumably was due to the higher concentra-

tions of NH4(+) and K found in the liquid sludge compared with those in the secondary sewage. To verify this assumption, the preference for NH4(+), K, and Na of the three soils was evaluated from cation exchange batch experiments; the preference for NH4(+) and K was an order of magnitude higher than that for Na. At a given total salt concentration, the sodicity levels decreased as more NH4(+) and K substituted for Na. The ionic activity product of CaCO3, which precipitated during the treatments with both wastewaters, had the same value and was higher than that of soil CaCO3. This difference was attributed to the inhibiting effect of the organic residues. (Author's abstract)
W87-01984

PHOSPHATE MOVEMENT IN COLUMNS OF SANDY SOIL FROM A WASTEWATER-IRRIGATED SITE,
Florida Univ., Gainesville. Dept. of Soil Science.
R. S. Mansell, P. J. McKenna, E. Flaig, and M. Hall.
Soil Science SOSCAK, Vol. 140, No. 1, p 59-68, July 1985. 7 fig, 7 tab, 16 ref. US Army Purchase order DACA89-79-M1699.

Descriptors: *Phosphate, *Municipal wastewater, *Land disposal, Breakthrough curves, Sorption, Desorption, Sorption isotherms, Mathematical models, Soil columns, Reaction rates, Soil chemistry, Irrigation, Astatula sand.

Using both a laboratory investigation and a mathematical model, the authors simultaneously described two-step sorption-desorption and movement of phosphate displaced through water-saturated columns of Astatula sand. Removal of P from the soil solution was assumed to proceed initially as a rapid physical adsorption step on sorption sites and to be followed by a slower chemisorption step. Soil columns were packed with surface soil materials from a pastured land area that had received periodic irrigation with municipal wastewater over a previous 7-yr period. Phosphate solution with 10 g/cu m was displaced through the saturated columns during steady liquid flow. Experimental P breakthrough curves and sorption isotherms were compared with those given by the model. The model provided general, but less than adequate, description of the P breakthrough curves for the relatively large pore velocities. Reaction rate coefficients obtained using only stirred batch sorption experiments provided less than desirable simulation of aqueous flow through soil columns. (Author's abstract)
W87-02004

PORE GAS COMPOSITION IN WASTE ROCK DUMPS UNDERGOING PYRITIC OXIDATION,
Australian Atomic Energy Commission Research Establishment, Sutherland.
For primary bibliographic entry see Field 5B.
W87-02010

FLOW AND CONTAINMENT OF INJECTED WASTES,
Du Pont de Nemours (E.I.) and Co., Wilmington, DE. Central Research and Development Dept.
C. Miller, T. A. Fischer, II, J. E. Clark, W. M. Porter, and C.H. Hales.
Ground Water Monitoring Review, Vol. 6, No. 3, p 37-48, Summer 1986. 14 fig, 1 tab, 37 ref.

Descriptors: *Injection wells, *Underground waste disposal, *Brine, *Groundwater movement, Plume models, Victoria, Texas, Permeability, Theis equation, Mathematical models, Multiplying-factor concept, Worst-case scenario, Prediction, Hantush and Jacob leaky aquifer theory, Geologic fractures, Geology, Gulf Coast.

A basic plume model was used to track waste from several injection wells with varied injection history at Dupont's Victoria, Texas, site. To determine the maximum distance that any portion of the waste might travel, special purpose models were employed to account for (1) density differences between the waste and the native formation brine, and (2) layered permeability variation within the injection zone. The results were generalized to a 'multiplying factor concept', which facilitates development of a worst-case scenario. A pressure distribution model based on the Theis equation for radial flow was applied, with modifcations to account for multiple wells, injection history, and geological complexities. Permeation into an intact confining layer was investigated by a new technique based on the Hantush and Jacob 'leaky aquifer' theory. The model defines the maximum permeation distance, taking into account post-injection pressure decay. Initial results indicate that faults and fractures are not likely to provide conductive pathways in Gulf Coast settings, and site-specific evaluations are required to assess the impact of abandoned wells. (Author's abstract)
W87-02052

SUBSURFACE DISPOSAL OF LIQUID LOW-LEVEL RADIOACTIVE WASTES AT OAK RIDGE, TENNESSEE,
Oak Ridge National Lab., TN.
S. H. Stow, and C. S. Haase.
Ground Water Monitoring Review, Vol. 6, No. 3, p 49-52, Summer 1986. 1 fig, 1 tab, 16 ref. DOE Contract DE-AC05-840R21400.

Descriptors: *Radioactive waste disposal, *Hydrofracture process, *Injection wells, *Oak Ridge National Laboratory, *Geologic fractures, *Bedding planes, *Regulations, Monitoring, Tiltmeter surveys, Leveling surveys, Microseismic monitoring, Tennessee.

Liquid low-level radioactive wastes have been disposed of by subsurface injection at Oak Ridge, Tennessee, for the last two decades. The process entails mixing the wastes with cement and other additives, then pumping the slurry under pressure into a highly impermeable shale; the pressure is sufficient to create bedding plane fractures in which the grout, containing, the wastes, sets. The hydrofracture process, site selection criteria, the characteristics of the Oak Ridge National Laboratory site, and development of monitoring procedures (leveling surveys, tiltmeter surveys, and microseismic monitoring) are discussed. The legislation governing well disposal that covers the Oak Ridge well was written with very different disposal techniques in mind. The well may be a Class V well, largely because it does not fit in the other categories. The present regulatory climate regarding injection wells has created an uncertain future for this technique. (Rochester-PTT)
W87-02053

CHEMICAL FATE OF INJECTED WASTES,
Du Pont de Nemours (E.I.) and Co., Wilmington, DE. Engineering Dept.
For primary bibliographic entry see Field 5B.
W87-02054

STUDY OF CURRENT UNDERGROUND INJECTION CONTROL REGULATIONS AND PRACTICES IN ILLINOIS,
Illinois State Water Survey Div., Champaign.
For primary bibliographic entry see Field 5G.
W87-02055

OPERATION AND MAINTENANCE OF UNDERGROUND INJECTION WELLS,
Du Pont de Nemours (E.I.) and Co., Victoria, TX.
J. R. Buttram.
Ground Water Monitoring Review, Vol. 6, No. 3, p 64-65, Summer 1986. 4 fig, 2 ref.

Descriptors: *Injection wells, *Underground waste disposal, *Well maintenance, *Well repairs, Victoria, Texas, DuPont Company, Leak detection, Monitoring, Well construction materials.

The DuPont Victoria, Texas, plant has gained 195 well-years of experience in operating and maintaining underground injection wells since 1953. This experience demonstrates that it is very important to locate wells where proper geology exists for groundwater protection. The well construction features and materials are equally important. Well operation at this plant features a leak detection system that continuously monitors the mechanical integrity of the wells. The evaluation of these monitoring data provides early detection of problems before the environment can be harmed. Investigations and diagnostic techniques are then used to determine the nature and exact location of the problems, whether they exist at the surface or downhole in the injection tubing, packer, or casing. Once the problem is defined, remedial action is initiated and the success of the repair is confirmed through additional testing. Only a limited number of repairs have been required over the past 33 yr and all have been carried out without endangering the environment. (Author's abstract)
W87-02056

CLASS I INJECTION WELL PERFORMANCE SURVEY,
Underground Injection Practices Council, Oklahoma City, OK.
M. J. Pacque.
Ground Water Monitoring Review, Vol. 6, No. 3, p 68-69, Summer 1986.

Descriptors: *Injection wells, *Underground waste disposal, *Malfunctions, *Drinking water, Environmental impact, Training, Failure studies, Operator error.

A study of Class I injection well malfunctions at 45 sites containing some 106 wells shows that most of the problems were related to outmoded designs or practices that would not be allowed under current minimum federal regulations. No documented health problems resulted from the well activity at any of the sites. At more than half of the sites no adverse environmental impact related to the well was found. Some type of incident related to injection was reported at 17 sites, but only four instances of leakage into an underground source of drinking water (USDW) were confirmed. In the instances of leakage into a USDW, the wastes were confined to areas near the well. Wells with sound preventive maintenance programs tended to have fewer problems. In some instances operator error rather than poor design or poor siting resulted in problems that could have been avoided if proper training programs were in place. The present study demonstrates that subsurface disposal of wastes can be environmentally sound when properly conducted and adequately regulated. (Rochester-PTT)
W87-02057

THEORY, CONSTRUCTION, AND OPERATION OF SIMPLE TENSIOMETERS,
For primary bibliographic entry see Field 7B.
W87-02058

INEXPENSIVE FLOW-THROUGH CELL AND MEASUREMENT SYSTEM FOR MONITORING SELECTED CHEMICAL PARAMETERS IN GROUND WATER,
Illinois State Water Survey Div., Champaign. Aquatic Chemistry Section.
For primary bibliographic entry see Field 7B.
W87-02059

SLUDGE TREATMENT AND DISPOSAL PROCESSES,
AZS Corp., Atlanta, GA.
J. Newton.
Water Pollution Control Association of Pennsylvania Magazine, Vol. 19, No. 3, p 6, 8, 10, 12, 14, 16, May-June 1986.

Descriptors: *Wastewater treatment, *Sludge conditioning, *Sludge disposal, Sludge thickening, Sludge disinfection, Sludge stabilization, Sludge drying, Composting, Soil amendments, Animal feed, Landfill topping, Energy sources, Construction materials, Clean Water Act, Resource Conservation and Recovery Act, Public policy.

Sludge treatment processes are described in terms of the following functional categories: sludge transportation and pumping, thickening, stabilization, conditioning, disinfection, dewatering, ther-

mal processes, composting, and ultimate disposal. Often certain of these functions can be combined to form a specific sludge treatment train, such as thickening, dewatering, composting, and reuse of the compost product. The impact of the Clean Water Act and the Resource Conservation and Recovery Act has been to encourage sludge generators to place more emphasis on utilization of sludge rather than on its disposal. Sludge has potential benefits as a soil amendment, source of heat and work, landfill topping, industrial raw material, animal feed, and construction material. (Rochester-PTT)
W87-02062

LEMOYNE, PA - SLUDGE DISPOSAL PRACTICES,
Lemoyne Joint Advanced Waste Treatment Facility, PA.
D. Heiner, Jr., and J. O'Neill.
Water Pollution Control Association of Pennsylvania Magazine, Vol. 19, No. 3, p 20-21, May-June 1986. 1 tab.

Descriptors: *Wastewater treatment, *Sludge disposal, *Advanced wastewater treatment, *Land application, *Incineration, *Landfills, Cost analysis, Wastewater facilities, Wastewater treatment, Lemoyne, Pennsylvania.

Sludge disposal at the Lemoyne Joint Advanced Waste Treatment Facility, a 2.088 MGD conventional activated sludge plant with lime addition, for P removal, was changed from disposal by contract hauler (to another treatment plant) to on-site processing and disposal by either land application (67%), incineration (15%), or landfill (18%). The processing described here yields an average 8,000 gallons/day, which has a sludge concentration of 8.4% (5,500 pounds dry solids/day). The present cost for treatment disposal of sludge averages $90,000 annually, or $89/day per dry ton. (Rochester-PTT)
W87-02064

SLUDGE INCINERATION AT KISKI VALLEY,
Ecoenergetics, Inc., Vacaville, CA.
T. R. Blaskovich.
Water Pollution Control Association of Pennsylvania Magazine, Vol. 19, No. 3, p 22, May-June 1986. 1 fig.

Descriptors: *Sludge incineration, *Wastewater treatment, *Grease, *Lagoons, *Cost analysis, Leechburg, Pennsylvania, Kiski Valley, Natural gas, Multiple-hearth incinerator, Wastewater treatment.

The Kiski Valley Water Pollution Control Authority, Leechburg, Pennsylvania, operates a natural gas-fired Environtech BSP multiple-hearth sludge incinerator with seven hearths, of which four have two natural gas burners each. Grease is collected and concentrated and burned separately; ash is settled in a lagoon. The facility has maintained compliance with air quality parameters since coming on-line in 1976; no serious operational problems have been encountered. Although natural gas costs $6,000/month, a cost analysis study showed that incineration on-site was more efficient than trucking of the sludge. (Rochester-PTT)
W87-02065

FEDERAL EVALUATION OF STRIPMINE RECLAMATION,
Environmental Protection Agency, Philadelphia, PA. Region III.
B. D'Angelo.
Water Pollution Control Association of Pennsylvania Magazine, Vol. 19, No. 3, p 26, May-June 1986. 14 ref.

Descriptors: *Strip mines, *Wastewater treatment, *Mine reclamation, *Soil management, *Land application, *Sludge disposal, *Pennsylvania, Secondary wastewater treatment, Philadelphia, Soil amendments, Environmental Protection Agency, Anaerobic digestion, Management planning, Sludge utilization, Feasibility studies.

On 24 August 1984, the Environmental Protection Agency (EPA) issued a Finding of No Significant Impact on the City of Philadelphia's (Pennsylvania) Facility Plan for Sludge Management. The plan describes the treatment technologies and sludge utilization plant that will be used to process the 300 dry tons/day of solids produced by the city's three secondary treatment facilities. Sludge will be anaerobically digested and then composted, with the composted product being used in one of three programs: (1) marketing as a soil conditioner (50%), (2) local land application (20-40%), and (3) stripmine reclamation in western Pennsylvania (10-30%). Numerous studies by EPA and various independent sources have concluded that land reclamation using sludge can be accomplished in an environmentally acceptable manner, but EPA has chosen to conduct an additional study, which is scheduled to be completed within 12 mo. (Rochester-PTT)
W87-02067

COMPOSTING: A SLUDGE MANAGEMENT METHOD GETS UPDATED,
Black and Veatch, Kansas City, MO.
J. H. Robinson, and R. D. Kuchenrither.
Water Pollution Control Association of Pennsylvania Magazine, Vol. 19, No. 3, p 27-30, 32, May-June 1986. 4 fig.

Descriptors: *Composting, *Wastewater treatment, *Sludge composting, *Thermal sterilization, *Aerobic sludge composting, *Reactor composting, Windrow composting, Aerated static pile composting, Philadelphia, Denver, Sludge curing, Cost analysis, Wastewater facilties, Sludge utilization.

The basic principles of composting are reviewed and facilities in use in several cities are described. Composting produces heat, which along with microbial action, renders sludge unrecognizable as such and free of pathogens, weed seeds, and insect eggs. Aerobic sludge composting systems can be classified as reactor and non-reactor types; in the first the composting occurs within a vessel (reactor), whereas in the second composting occurs in the open air outside any containment vessel. The reactor approach uses less land and offers better odor control, but has high capital cost and greater complexity. Non-reactor programs can be divided into aerated static pile and windrow processes. Aerated static pile systems of the type used in Philadelphia and other cities and windrow processing as employed in Denver and elsewhere in the west are described here. Problems of aeration and combining curing/composting to reduce costs are discussed. (Rochester-PTT)
W87-02068

SLUDGE MANAGEMENT PRACTICES IN PHILADELPHIA,
Philadelphia Water Dept., PA. Sludge Management Unit.
F. Senske, and K. Ellis.
Water Pollution Control Association of Pennsylvania Magazine, Vol. 19, No. 3, p 32-37, May-June 1986. 4 fig, 1 tab, 1 ref.

Descriptors: *Sludge utilization, *Wastewater treatment, *Sludge disposal, *Philadelphia, *Land application, *Landfills, *Strip mines, *Composting, *Soil management, Pennsylvania, Soil conditioner, Monitoring, Cadmium, Chromium, Copper, Lead, Nickel, Zinc, Polychlorinated biphenyls, Horse racing tracks, Roof deck planters, Landscaping.

The Philadelphia (Pennsylvania) Water Department, which processes wastewater for the city and surrounding communities over a 360 sq mi area, has developed a sludge marketing program to ensure use of sludge in various programs. Screened compost, mixed with sand, has been used in rehabilitation of horse racing tracks, for roof deck planters on hotels, and dewatered sludge has been trucked to Delaware for use in composting there. A bulk application program was developed for land application in agriculture and landfill revegetation and in stripmine reclamation in western Pennsylvania. Another program involves allowing small users to load their own 'Philorganic' (a mixture of composted sludge and wood chips) for use a soil conditioner at no cost. Product quality is maintained by frequent (daily or biweekly sampling) of incoming wastewaters to ensure that pollutant limits are met. Philadelphia sludge in 1984 averaged below the Pennsylvania Department of Environmental Resources limits for Cd, Cr, Cu, Pb, Ni, Zn, and polychlorinated biphenyls. (Rochester-PTT)
W87-02069

LANDFILLING EXPERIENCE AT CITY OF LANCASTER,
Sewage Operations, Lancaster, PA.
L. S. Vanzile.
Water Pollution Control Association of Pennsylvania Magazine, Vol. 19, No. 3, p 40-41, May-June 1986.

Descriptors: *Landfills, *Sludge disposal, *Belt filter press, *Wastewater facilities, Lancaster, Pennsylvania, Incineration, Composting, Cost analysis, Heat treatment.

The city of Lancaster (Pennsylvania) was denied the use of its landfill site in 1983 due to leachate problems. In response the city instituted a sludge dewatering program using a belt filter press, coupled with stabilization in a static pile system, which is followed either by distribution by the composting company or incineration of the excess. Due to the decrease in solids concentration, the annual sludge production was increased from 3,600 tons/yr with the vacuum filter previously used to 6,300 tons/yr with the filter press, which increased the sludge disposal cost by over $54,000 above the previous method. This was more than offset, however, because the use of Zimpro heat treatment system was discontinued. (Rochester-PTT)
W87-02070

INNOVATIVE SLUDGE MANAGEMENT: IMAGINATION AND TECHNOLOGY GO A LONG WAY TO SOLVE A CITY'S SLUDGE PROBLEM,
VFL Technology Corp., Malvern, PA.
L. M. Ruggiano.
Water Pollution Control Association of Pennsylvania Magazine, Vol. 19, No. 3, p 42-43.

Descriptors: *Sludge disposal, *Fly ash, *Sludge lagoons, *Sludge solids, *Land application, *Landfills, Dredge spoils, Dikes, Wilmington, Delaware, Coal, Electric powerplants, *Wastewater treatment, Sludge utilization.

The city of Wilmington (Delaware) has entered an agreement with VFL Technology Corporation to stabilize the sludge resulting from treatment operations at its 70 mgd wasteswater treatment system. VFL performs a two-staged stabilization procedure on the sludge: (1) fly ash from coal-burning electric power plants is hauled to the sludge storage lagoons and incorporated into the sludge by backhoe and (2) dry lime kiln dust is uniformly incorporated into the pre-blended sludge-ash mix using a proprietary injection system mounted at the end of a backhoe. The conditioned fly ash increases the solids content of the lagooned sludge. After treatment with lime-kiln dust the material undergoes a pozzolanic reaction that ties up the free water in the sludge, yielding a solidified end product. The stabilized sludge is then used in slope covering and berm fill at a land fill and as low permeable structural fill for dikes to contain pumped dredge spoils. (Rochester-PTT)
W87-02071

NITROGEN MINERALIZATION OF SEWAGE SLUDGES IN SOILS,
Barcelona Univ. (Spain). Facultat de Farmacia.
M. A. Garau, M. T. Felipo, and M. C. Ruiz de Villa.
Journal of Environmental Quality JEVQAA, Vol. 15, No. 3, p 225-228, July-September 1986. 6 tab, 27 ref.

Descriptors: *Nitrogen, *Mineralization, *Soil absorption capacity, *Sludge utilization, Leaching, Incubation, Aerobic sludge.

Nitrogen mineralization of two sludges by two soil types was studied using leached and nonleached incubation procedures. Cumulative nitrogen increased linearly with incubation time and sludge incorporation rate. Mineralization was influenced more by soil type than by sludge type or application rate. The amount of mineralized nitrogen was higher for the leaching procedure. Cumulative nitrogen was inversely dependent on the application rate for the leached procedure, but was independent of application rate for the nonleached procedure. Mineralization potential increased with the application rate and was higher for aerobic sludge on neutral soil. The leached method seems more representative of field conditions due to elimination of inorgnic nitrogen mineralized during incubation periods, thus reflecting plant absorption. (Michael-PTT)
W87-02087

PROTON AND METAL COMPLEXATION BY WATER-SOLUBLE LIGANDS EXTRACTED FROM ANAEROBICALLY DIGESTED SEWAGE SLUDGE,
Oregon State Univ., Corvallis. Dept. of Soil Science.
J. Baham, and G. Sposito.
Journal of Environmental Quality JEVQAA, Vol. 15, No. 3, p 239-244, July-September 1986. 4 fig, 2 tab, 33 ref.

Descriptors: *Anaerobic digestion, *Sludge, *Solubility, *Soil adsorption capacity, *Complexation, *Trace metals, *Speciation, Acidity, Titration, Organic ligands, Protons, Metals, Cadmium, Curium, Adsorption, Copper, Filtration, Nickel.

Proton titration data are presented for water-soluble organic and inorganic titratable groups extracted from anaerobically digested sewage sludge. The titration curve represents the acid-base chemistry of a mixture of ligands which might be expected to occur in a soil solution shortly after application of sludge. Copper formed the more stable complexes with the ligands as compared to nickel and cadmium, which was present in the free metal ion or in inorganic complexes. The primary factor controlling copper solubility was the formation of soluble organo-copper complexes. A 'mixture model' to simulate proton formation is developed which is consistent with actual concentrations of known functional groups in the water-soluble extract. This model is used to simulate curium and cadmium speciation in gel filtration and adsorption experiments. (Michael-PTT)
W87-02089

EFFECT OF SLUDGE ADDITIONS ON NITROGEN REMOVAL IN SOIL COLUMNS FLOODED WITH SECONDARY EFFLUENT,
Agricultural Research Service, Durant, OK. Water Quality and Watershed Research Lab.
J. C. Lance.
Journal of Environmental Quality JEVQAA, Vol. 15, No. 3, p 298-301, July-September 1986. 2 fig, 1 tab, 16 ref.

Descriptors: *Sludge utilization, *Nitrogen removal, *Soil columns, *Effluents, Infiltration, Decomposition, Organic carbon, Denitrification, Bacteria, Mixing, Groundwater basins.

Sludge was mixed with a surface layer of soil to test the possibility of increasing nitrogen removal in soil columns flooded with secondary effluent. Infiltration rates of the two tested columns were 30 and 60 centimeters per day (cm/d). Nitogen removal at the 30 cm/d infiltration rate was greater than that for the 60 cm/d infiltration rate, and was sufficient to maintain the average total nitrogen content in outlet water at eight milligrams per liter. Sludge decomposition in the soil columns also provided a source of organic carbon for denitrifying bacteria. Results show that mixing sludge with soil in groundwater basins could raise application rates for sewage water and thereby reduce wastewater disposal costs. (Michael-PTT)
W87-02096

PHOSPHORUS SOLUBILITY IN SLUDGE-AMENDED CALCAREOUS SOILS,
New Mexico State Univ., Las Cruces. Dept. of Crop and Soil Sciences.
G. A. O'Connor, K. L. Knudtsen, and G. A. Connell.
Journal of Environmental Quality JEVQAA, Vol. 15, No. 3, p 308-312, July-September 1986. 3 fig, 3 tab, 9 ref. DOE Contract DE-AC04-83AL21776.

Descriptors: *Phosphorus, *Solubility, *Sludge utilization, *Calcareous soils, New Mexico, Lead, Calcium phosphorus compounds, Accumulation, Fertilization, Hydrogen ion concentration.

The effects of sewage sludge additions on phosphorus solubility relationships in calcareous New Mexico soils was investigated in greenhouse and field studies. Phosphorus was expressed using solubility diagrams for secondary calcium compounds commonly found in soils. The solubility of these compounds and the solution composition of soil extracts were plotted in terms of double function parameters. Sludge additions increased water soluble NaHCO3-extractable phosphorus and plant uptake of phosphorus. Ancilliary effects, particularly a slight reduction in pH, were apparently responsible for increased phosphorus solubility in amended soils. (Michael-PTT)
W87-02098

HARVESTING DAPHNIA MAGNA GROWN ON URBAN TERTIARILY-TREATED EFFLUENTS,
Laval Univ., Quebec. Dept. de Biologie.
For primary bibliographic entry see Field 3C.
W87-02163

EFFECT OF IRON OXIDE REMOVAL ON HEAVY METAL SORPTION BY ACID SUBSOILS,
Delaware Univ., Newark. Dept. of Agricultural Engineering.
H. A. Elliott, M. R. Liberati, and C. P. Huang.
Water, Air, and Soil Pollution WAPLAC, Vol. 27, No. 3/4, p 379-389, 1986. 4 ref.

Descriptors: *Land disposal, *Path of pollutants, *Iron oxide, *Heavy metals, *Sorption, *Acid subsoils, Sediments, FAAS, Adsorption.

The adsorption of Cd, Cu, Pb, and Zn from 0.025 M NaClO4 solutions by two ferruginous subsoils was investigated. Under acidic conditons, selective dissolution and removal of the Fe oxide soil component by dithionite citrate-bicarbonate (DCB) generally increased heavy metal adsorption by the soils. This effect was attributed to increased electrostatic attraction of cations of the DCB-washed soils as evidenced by substantial reduction in the zero point of charge for the Dothan soil following DCB extraction. Alternately, the DCB extraction stripped Fe and Al species bound to structural exchange sites or eliminated coatings which reduce cation accessibility to such sites. Addition of low levels of ferric iron suppressed heavy metal adsorption capacity of the DCB-extracted Christiana soil to values comparable to the unmodified whole soil system. While hydrous oxide surfaces represent highly reactive sites for cation binding, Fe oxides can modify both the pH-dependent and structural exchange sites in a manner that hinders heavy metal adsorption. Thus, a soil's Fe-oxide content is unlikely to be a reliable guide to heavy metal adsorption capacity. (Author's abstract)
W87-02194

WATER CYCLE AS A SOURCE OF PATHOGENS,
North West Water Authority, Warrington (England).
For primary bibliographic entry see Field 5B.
W87-02208

BACTERIAL POLLUTION OF COASTAL WATERS IN THE UK AND MEDITERRANEAN,
Newcastle upon Tyne Univ. (England). Dept. of Civil Engineering.
For primary bibliographic entry see Field 5C.
W87-02213

POTENTIAL RISKS TO HUMAN AND ANIMAL HEALTH ARISING FROM LAND DISPOSAL OF SEWAGE SLUDGE,
North West Water Authority, Warrington (England).
D. C. Watson.
Journal of Applied Bacteriology (Symposium Supplement) JABAA4, p 95S-103S, 1985. 2 fig, 2 tab, 38 ref.

Descriptors: *Sludge disposal, *Land disposal, *Public health, Salmonella, Bacteria, Helminths, Viruses, Contamination, Pathogens, Agricultural runoff, Sludge utilization, Wells.

The risks to human health and animals from land disposal of sewage sludge are discussed. The scope and type of disease risks from salmonella, other bacteria, parasitic helminths and viruses are examined. The risk of well contamination from water travel of pathogenic organisms through the soil of sludge treated agricultural lands is also reviewed. (Michael-PTT)
W87-02214

SOLID WASTE COMPOSTING GAINS NEW ENERGY,
For primary bibliographic entry see Field 5D.
W87-02242

LIQUID SLUDGE VS. NITROGEN FERTILIZER,
Colorado State Univ., Fort Collins. Dept. of Agronomy.
For primary bibliographic entry see Field 3C.
W87-02243

COMPOSTING PROCESS DESIGN CRITERIA: PART I-FEED CONDITIONING,
For primary bibliographic entry see Field 5D.
W87-02244

LONG TERM ASSESSMENT OF NON-HAZARDOUS OILFIELD WASTE PITS,
Tulane Univ., New Orleans, LA. Dept. of Environmental Health Sciences.
R. S. Reimers, P. S. deKernion, and A. A. Abdelghani.
Biocycle BCYCDK, Vol. 27, No. 7, p 44-49, August 1986. 9 tab, 19 ref.

Descriptors: *Oil fields, *Waste pits, *Testing procedures, Fate of pollutants, Organic wastes, Inorganic compounds, Sorption, Chemical wastes, Clay, Leaching, Mud.

Testing methodologies for the assessment of Non-Hazardous Oilfield Waste (NOW) pits are reviewed and evaluated. Extraction procedures are recommended for deterining concentrations of organic and inorganic wastes and biologically and non-biologically active organic wastes in NOW pit mud samples. Sorption affinity is important in assessing chemical mobility and determining the fate of chemicals. It is recommended that compatibility tests be used to determine the effectiveness of clay liners in preventing water leaching through the cover of a closed pit. (Michael-PTT)
W87-02245

ALGAL SEPARATION BY THE LIME-SEAWATER PROCESS,
Florida Univ., Gainesville. Dept. of Environmental Engineering Sciences.
For primary bibliographic entry see Field 5D.
W87-02353

PILOT PLANT STUDY ON WATER QUALITY CHANGES DURING GROUNDWATER RECHARGE,

Ministerie van Volksgezondheid en Milieuhygiene, Leidschendam (Netherlands).
J. Hrubec, J. A. Luijten, W. C. M. M. Luijten, and G. J. Piet.
Water Research WATRAG, Vol. 20, No. 9, p 1119-1127, September 1986. 3 fig, 5 tab, 26 ref.

Descriptors: *Groundwater quality, *Groundwater recharge, *Rhine River, Sand, Soil organic matter, Halogenated compounds, Organic compounds, Chemical oxygen demand, Dissolved organic carbon, Anaerobic conditions, Ammonia, Phosphates, Iron, Manganese, Silicates, Arsenic.

Results of a pilot plant study on the influence of the composition of sandy soil on water quality changes during groundwater recharge of pretreated Rhine water are presented. It is confirmed that content and nature of the soil organic matter substantially affect the quality of the percolating water. Recharge in the sand with a higher content of unstable organic matter (0.76% OC), under anaerobic conditions (E sub h approximately = +100 mV) resulted in an increase of COD, DOC, NH4(+), PO4(3-), Fe, Mn, SiO2 and As content. However, the concentration of trihalomethanes, tetrachloromethane, 1,1,1-trichloroethane, tetrachloroethene, haloacetonitriles, nitro-aromatics and the mutagenic activity decreased during the recharge. Passage through the sand with a lower content of stabilized organic matter (0.22% OC), under anaerobic conditions (E sub h approximately = +200 mV), showed a similar but less pronounced effect. In the sand with very low content organic matter (0.04% OC) under aerobic conditions, a moderate improvement of macroconstituents and trace elements was observed. From the organic micropollutants studied, only brominated trihalomethanes were transformed here to a degree increasing with the bromine content. Adsorbable and extractable halogenated organic compounds formed by the chlorination of the recharge water, characterized with the group parameters (AOX and EOX), were largely removed during the percolation in all sands examined. (Author's abstract)
W87-02358

RECLAMATION AND RE-USE OF DOMESTIC WASTEWATER AND REVERSE OSMOSIS REJECT WATER,
Post, Buckley, Schuh and Jernigan, Inc., Fort Myers, FL.
For primary bibliographic entry see Field 3C.
W87-02487

DISPOSAL OF REVERSE OSMOSIS WATER TREATMENT PLANT REJECT WATER BY INJECTION WELL: AN ASSESSMENT OF GEOCHEMICAL PLUGGING,
Missimer and Associates, Inc., Cape Coral, FL.
T. H. O'Donnell, T. M. Missimer, and I. Watson.
IN: Is Current Technology the Answer, Proceedings of the First Biennial Conference of the National Water Supply Improvement Association, June 8-12, 1986, Washington, DC. (1986). p 346-378, 3 fig, 3 tab, 26 ref.

Descriptors: *Reverse osmosis, *Injection wells, *Geochemistry, *Plugs, Performance evaluation, Wastewater disposal, Calcite, Dolomite, Gypsum, Apatite, Boreholes, Aquifers, Chemical precipitation, Hydrogen ion concentration, Geohydrology.

Reject water produced by reverse osmosis water treatment plants is chemically unstable with regard to the saturation of certain minerals, such as calcite (calcium carbonate), dolomite (calcium-magnesium carbonate), gypsum (calcium sulfate), and in certain cases, apatite (calcium phosphate). If the reject water is discharged to a tidal surface water body, the unstable water is diluted and rarely causes any significant problem. However, if the reject water must be eliminated via an injection well, the chemical instability of the water becomes a significant problem. When a water supersaturated with calcium carbonate or certain other minerals enters a limestone aquifer, precipitation of calcite will occur somewhere in the borehole or at some distance from the borehole in the aquifer. The rate of precipitation and the distance from the borehole at which it occurs is controlled principally by the total dissolved solids concentration, pH, and selected gas and ion concentrations in the reject stream. Mineral precipitates can completely plug the injection well to a degree that it cannot be rehabilitated. Based on theoretical considerations and observations, it is necessary to stabilize reverse osmosis reject water before it is injected at high rates into the groundwater system. Careful consideration should be given to the use of this disposal technique in certain hydrogeologic settings. (See also W87-02476) (Author's abstract)
W87-02492

REMEDIAL ALTERNATIVES FOR SOURCE ABATEMENT: THE NECESSARY STEP,
O.H. Materials Co., Findlay, OH.
For primary bibliographic entry see Field 5B.
W87-02504

DESIGN AND INSTALLATION OF DEEP MULTILEVEL PIEZOMETER NESTS IN COLUMBIA RIVER BASALTS AT THE HANFORD SITE, WASHINGTON,
Atomics International Div., Richland, WA. Rockwell Hanford Operations.
For primary bibliographic entry see Field 7B.
W87-02508

DEVELOPMENT OF A GROUND WATER MODEL UTILIZING THE INSTALLATION AND TESTING OF A VARIABLE DEPTH CLUSTER MONITORING WELL NETWORK,
Hess (R.K.R.) Associates, Stroudsburg, PA.
For primary bibliographic entry see Field 7A.
W87-02518

5F. Water Treatment and Quality Alteration

FEW PROBLEMS WITH WATER ENCOUNTERED IN BRAZIL (QUELQUES PROBLEMES DE L'EAU ENCONTRES AU BRESIL),
Office de la Recherche Scientifique et Technique Outre-Mer, Paris (France).
P. Dubreuil.
La Houille Blanche, Vol. 85, No. 2, p 111-122, 1985. 5 fig, 14 tab, 6 ref.

Descriptors: *Brazil, *Water problems, *Geography, *Human population, *Water resources development, Amazon River, Administration.

Reflections on 20 yr in working with water problems with Brazilian specialists are presented. It highlights a few problems of interest and describes several situations that can be encountered in evaluating, exploiting, and managing the water resources of this highly varied country. Brazil is fifth in the world in size, seventh by population (1980), and tenth in gross national product (1980), and it contains the terminal course of the largest river in the world, the Amazon. Topics discussed are the economic geography of Brazil's varied regions, total surface water resources of Brazil, problems of the Amazon water resources and ecosystem, problems of the northeast, conflicts in water usage, and administrative structure of water supply. (Rochester-PTT)
W87-01967

HIGH LEVELS OF MUTAGENIC ACTIVITY IN CHLORINATED DRINKING WATER IN FINLAND,
Kuopio Univ. (Finland). Dept. of Chemistry.
For primary bibliographic entry see Field 5B.
W87-02041

PARTICLE REMOVAL BY HORIZONTAL-FLOW ROUGHING FILTRATION,
Eidgenoessische Anstalt fuer Wasserversorgung, Abwasserreinigung und Gewaesserschultz, Duebendorf (Switzerland).
M. Wegelin, M. Boller, and R. Schertenleib.
Aqua AQUAAA, No. 3, p 115-125, 1986. 24 fig, 1 tab, 7 ref.

Descriptors: *Filtration, *Horizontal-flow roughing filtration, *Slow sand filtration, *Analytical models, *Particle removal, *Turbidity, *Water treatment, Switzerland, Filters, Developing countries, Surface water, Reclaimed water, Design.

Horizontal-flow Roughing Filtration (HRF) is presented as an alternative pretreatment method prior to Slow Sand Filtration (SSF). The prefilters efficiently remove solid matter from turbid water without the use of chemicals or mechanical equipment. The structures and mechanisms of HRF are described, and a brief summary is presented of laboratory tests conducted in Switzerland and the analytical model developed from them. Practical information on filter design also is given. HRF separates the solid matter in the water that would cause rapid clogging of SSF. Therefore, this pretreatment process will prolong considerably the running time of SSF to several months necessary for a reasonable filter operation. The combination of HRF and SSF represents a reproducible and reliable water treatment process for developing countries that is free from foreign inputs such as chemicals and is able to produce an appealing and hygienically safe drinking water from polluted surface water. (Rochester-PTT)
W87-02044

WATER DISTRIBUTION IN SICILY,
A. Montalto.
Aqua AQUAAA, No. 3, p 126-132, 1986. 10 fig, 1 tab, 19 ref.

Descriptors: *Sicily, *Management planning, *Water supply development, *Reservoirs, Dams, Networks, Water authority, Intake works, Elevation.

The reservoir situation in Sicily is described, including dams and artificial lakes, geography, hydrology, proposals for dividing the island into water regions and linking both reservoirs within regions and the regions themselves, and discussion of planning issues in the regulation and distribution of water in Sicily. A listing of reservoirs and their characteristics, diagrams of intake works elevation relationships, and flow charts of water systems management are included. The author concludes that a unified water distribution system, ultimately possibly managed by a single authority, although calling for a substantial outlay, would solve Sicily's water problems. (Rochester-PTT)
W87-02045

MANAGING WATER,
Water Industry Training Association, Tadley (England).
D. Hughes, and R. Campsie.
Aqua AQUAAA, No. 3, p 134-136, 1986.

Descriptors: *Management planning, *Training, *Water supply systems, *Personnel, England, Wales, France, Sweden, World Health Organization, Organizations, Management development.

Needs of modern managers, including analyses of the water management situation and progress in management development in various countries, are discussed. Information from England and Wales, France, Sweden, and the World Health Organization is presented. Changing situations in the water-supply field and the nature of water-supply organizations contributed to the pressures on managers. Water supply organizations pay close attention to selection of managers and then to their systematic development. The problems faced by water-supply authorities in the area of management development and some of the solutions they have devised are discussed. (Rochester-PTT)
W87-02046

TRAINING FOR WATER IN INDIA,
Ministry of Urban Development, New Delhi (India).
V. Venugopalan.
Aqua AQUAAA, No. 3, p 139-142, 1986. 2 append.

Descriptors: *Training, *Developing countries, *Water supply development, *Courses of study, Management, Water supply system, Corrosion control, Water treatment, Water analysis, Sewage analysis, Pipes, Conduits, Chlorination, Public health engineering, Filter operators, Computers, Desalination, Maintenance, Leak detection, South-east Asia, Cost analysis, Financial aid, Students, Nirman Bhavan, India.

The training needs of a country developing its water supply are outlined, with a listing of courses, minimum qualifications for admission, costs, periods of study, and financial support of attendees. Examples are drawn from the courses run in Nirman Bhavan, India. Refresher courses described are: water works supervisors' course, water supply system managment, corrosion control, new developments in water treatment, water treatment plant design, drilling techiques, pipes and conduits, filter operators' course, water and sewage analysis, care and use of chlorinators, and distribution system analysis using computers. Specialized courses cover such topics as water desalination, preventive maintenance and leak detection, South East Asian study tours, and short-term public health engineering courses. (Rochester-PTT)
W87-02047

APPLYING ACTIVE EDUCATIONAL METHODS FOR TRAINING IN THE WATER SECTOR (LES METHODES PEDAGOGIQUES ACTIVES APPLIQUEES AUX METIERS DE L'EAU),
Compagnie Generale des Eaux, Paris (France).
For primary bibliographic entry see Field 9B.
W87-02048

ENSURING THE OPERATION AND MAINTENANCE OF WATER SUPPLY SYSTEMS,
Mansfield Coll., Oxford (England).
D. J. Kinnersley.
Aqua AQUAA, No. 3, p 147-149, 1986.

Descriptors: *Water supply systems, *Operations, *Maintenance, *Organizations, *Public participation, *Water supply, *Water treatment, River basins, Institutions, Public policy.

The need to sustain the water supply once it is introduced, is presented with discussion of the nature of a sustainable system, the negative effect of new works (which may carry more professional and political glamour), thus drawing funds and professional talent away from operational arrangements, the role of national policies and water management agencies in different countries, and principles of institutional arrangements. The author suggests two points important to water professionals: (1) keep water supply and sanitation management close to the people, so they sustain it; an (2) recognize that water management broadly defined has to be river-basin oriented. (Rochester-PTT)
W87-02049

TRAINING FOR WATER IN AFRICA, (LA FORMATION DANS LE DOMAINE DE L'EAU EN AFRIQUE),
Societe de Distribution d'Eau de la Cote-d'Ivoire, Abidjan.
K. Manlan.
Aqua AQUAA, No. 3, p 150-153, 1986.

Descriptors: *African Union of Water Suppliers, *Training, *Maintenance, Benin, Cameroon, Central African Republic, Guinea, Ivory Coast, Gabon, Liberia, Mali, Mauritania, Morocco, Niger, Togo, Tunisia, Senegal, Zaire, Policy.

A survey of progress made in training by members of the African Union of Water Suppliers (L'Union Africaine des Distributeurs d'Eau, UADE) is summarized. Each country is reviewed in turn and recommendations are made that might be taken individually or in a group. Countries from which information was obtained include Benin, Cameroon, Central African Republic, Guinea, Ivory Coast, Gabon, Liberia, Mali, Mauritania, Morocco, Niger, Togo, Tunisia, Senegal, and Zaire. Attention is drawn to the critical need for training in maintenance. Training methods are mentioned, and the balance between local, national and international efforts and particular priorities are examined. (Rochester-PTT)
W87-02050

MICRO-ELECTRONICS IN THE WATER INDUSTRY - THE IMPORTANCE OF PEOPLE,
Institution of Water Engineers and Scientists, London (England).
A. D. Rance, and S. J. Bowden.
Aqua AQUAAA, No. 3, p 154-160, 1986. 1 tab, 7 ref.

Descriptors: *Automation, *Technology transfer, *Management planning, *Systems engineer, Personnel, Water industry, Training, Computers, Microelectronics, Systems approach, Water management.

Training personnel in the water industry is described as a planned activity, which should not be left to chance. People involved in training include management, finance and administration staff, engineers and scientists, craftsmen, technician engineers and technicians, and operators. The qualities, training, and role of the systems engineer, who will be increasingly in demand as water authorities introduce more instrumentation, control, and automation into their operations, are described. The overall success of future projects and their various microelectronic components will rely on the ability of the industry to develop new types of expertise in the areas of design, operation, and maintenance. The 'systems' approach to solving water industries problems is seen by the authors as a particularly important development, because if the approach is adopted additional types of skill will need to be established. (Rochester-PTT)
W87-02051

SCADA SYSTEMS TODAY AND TOMORROW,
Engineering Design Group, Inc., Tulsa, OK.
For primary bibliographic entry see Field 7B.
W87-02105

COMPUTERIZED WATER SYSTEM: FROM PITFALLS TO PERFECTION,
Greeley and Hansen, Chicago, IL.
For primary bibliographic entry see Field 7B.
W87-02107

THEORETICAL AND HYDRAULIC MODEL STUDY OF A CHLORINE CONTACT TANK,
Birmingham Univ. (England). Dept. of Civil Engineering.
R. A. Falconer, and T. H. Y. Tebbutt.
Institution of Civil Engineers Proceedings PCIEAT, Vol. 81, Part 2, p 255-276, June 1986. 11 fig, 5 tab, 15 ref.

Descriptors: *Hydraulic models, *Water treatment, *Contact tanks, *Retention time, *Chlorination, *Flow pattern, Flow velocity, Flow characteristics, Diffusion, Dispersion, Prototypes, England, Mathematical models, Mathematical equations, Hydraulic systems, Hydraulic design, Hydraul equipment, Flow measurement, Field tests.

A free surface flow laboratory study was conducted to improve flow patterns in prototype chlorine contact tanks for a Birmingham, England treatment facility. Modifications aimed at reducing short circuiting, optimizing retention times and reducing dead space areas were evaluated using different laboratory model tank configurations. Theoretical analysis established the influence of longitudinal dispersion and turbulent diffusion on ideal plug flow through the tanks so that accurate numerical values could be obtained for the time ratios used to quantify short circuiting and retention times. Velocity measurements and dye tracer studies were performed. Model predictions were checked by comparing measured flow through curves in the laboratory tanks with those in the prototype tanks. Tank modification recommendations were implemented and field measurements confirmed improvement in flow through characterisitics and retention times. (Michael-PTT)
W87-02121

MICROSCALE FLUCTUATION ASSAY COUPLED WITH SEP-PAK(R) CONCENTRATION AS A RAPID AND SENSITIVE METHOD FOR SCREENING MUTAGENS IN DRINKING WATER,
Perugia Univ. (Italy). Cattedra di Igiene.
For primary bibliographic entry see Field 5A.
W87-02148

MODELLING HEAD LOSS IN DEEP BED FILTRATION OF HYDROXIDE FLOCS,
Bekaert (N.V.) S.A., Zwevegem (Belgium).
R. J. Francois, and A. A. Van Haute.
Water Research WATRAG, Vol. 19, No. 10, p 1241-1248, 1985. 9 fig, 4 tab, 10 ref.

Descriptors: *Mathematical models, *Water treatment, *Filtration, *Hydroxide flocs, Bulking factor, Pilot plants, Mathematical equations, Filters, Prediction.

A modified filter coefficient model was adapted to predict head loes during deep bed filtration of hydroxide flocs. The differences between the drop in pressure calculated by the model and that measured at a an industrial pilot plant decrease significantly if the constant bulking factor is replaced by a variable optimal bulking factor, which is a function of both filtration time and filter depth. The optimal bulking factor-time relationship is calculated with the best fitting model for 11 different experiments. The relation consists of two linear parts if none or only a very small amount of polyelectrolytes is used, at higher doses of which the relation is hyperbolic. The optimal bulking factor is found to be a combination of a constant bulking factor for influent flocs, a slowly decreasing bulking factor for filter bed deposits which are subject to aging phenomena and a sharply decreasing bulking factor which translates the volume of voids blocked during the beginning of a filter run. (See also W87-02153) (Author's abstract)
W87-02152

STRUCTURE OF HYDROXIDE FLOCS,
Bekaert (N.V.) S.A., Zwevegem (Belgium).
R. J. Francois, and A. A. Van Haute.
Water Research WATRAG, Vol. 19, No. 10, p 1249-1254, 1985. 11 fig, 3 tab, 19 ref.

Descriptors: *Hydroxide flocs, *Water treatment, *Structural models, *Coagulation, *Flocculation, Metal salts, Hydrolysis, Kaolinite, Kinetics, Aggregates.

That no good structural model exists for gelatinous hydroxide flocs is demonstrated through a survey of floc structure literature. This investigation uses hydrolizing metal salts for coagulation-flocculation of very dilute kaolinite suspensions. The influence of kinetic processes is used to prove the validity of a four level organization of hydroxide floc aggregates. This organization includes flocculi, flocs and floc aggregates. The bonds between the particles of the different levels are shown to be elastic. (See also W87-02152) (Author's abstract)
W87-02153

DIFFERENT REACTION MECHANISMS BY WHICH CHLORINE AND CHLORINE DIOXIDE REACT WITH POLYCYCLIC AROMATIC HYDROCARBONS (PAH) IN WATER,
Hadassah Medical School, Jerusalem (Israel). Environmental Health Lab.
C. Rav-Acha, and R. Blits.
Water Research WATRAG, Vol. 19, No. 10, p 1273-1281, 1985. 12 fig, 4 tab, 28 ref.

Descriptors: *Chlorine, *Chlorine dioxide, *Water treatment, *Polycyclic aromatic hydrocarbons, Oxidation, Disinfection, Organic compounds, Carcinogens, Molecular structure.

PAH removal by chlorine or chlorine dioxide disinfection is investigated in terms of the different mechanisms by which two oxidants react with

aquatic organics. The differences between the rates at which Cl2 and ClO2 react with various PAH and physical and chemical factors affecting those reactions indicate that chlorine reacts with PAH by several possible mechanisms, including addition, substitution and oxidation. Chlorine dioxide reacts mainly as a pure oxidant and a one-electron acceptor. Chlorine dioxide reacts more specifically with those PAH that undergo facile oxidation. Some PAH that react easily with Cl2 do not react at all with ClO2, while others react with ClO2 much more rapidly than with Cl2. For example, highly carcinogenic benzo(a)pyrene and benzo(a)anthracene react with ClO2 much faster than with Cl2. (Author's abstract)
W87-02157

CONTROL OF SCHISTOSOMIASIS IN THE NEW RAHAD IRRIGATION SCHEME OF CENTRAL SUDAN,
Blue Nile Health Project, Wad Medani (Sudan).
O. Tameim, Z. B. Zakaria, H. Hussein, A. A. El Gaddal, and W. J. Jobin.
Journal of Tropical Medicine and Hygiene, Vol. 88, No. 2, p 115-124, April 1985. 5 fig, 7 tab, 10 ref.

Descriptors: *Schistosomiasis, *Rahad, *Irrigation, *Sudan, Diseases, Water-associated diseases, Cost control.

The new Rahad Irrigation Scheme in Central Sudan began its first agricultural season in 1978. The Blue Nile Health Project was being developed to prevent schistosomiasis and other diseases in the Rahad and Gezira-Managil schemes. The prevalence of infection among children in the newly established schools was found initially to be 14% for Schistosoma mansoni and 1% for Schistosoma haematobium in 1980. In the older Gezira-Managil areas there was also a little prevalence of the former but the prevalence of S. mansoni in school children was above 70%. An integrated control strategy was implemented in 1980 using chemotherapy and snail control, supported by safe water supplies in every village. The prevalence of S. mansoni was reduced below 10% at an annual cost of less than $4 per capita. S. haematobium remained at 1% in schoolchildren in 1983. The major cost was for village water supplies. Economically feasible prevention of transmission for long-term applications will require a reduction of the annual cost to about $1 per capita. (Author's abstract)
W87-02181

SIGNIFICANCE OF WATER MANAGEMENT IN RELATION TO PUBLIC AND ENVIRONMENTAL HEALTH,
World Health Organization, Copenhagen (Denmark). Regional Office for Europe.
For primary bibliographic entry see Field 5G.
W87-02206

MATERIALS USAGE AND THEIR EFFECTS ON THE MICROBIOLOGICAL QUALITY OF WATER SUPPLIES,
Thames Water Authority, London (England).
J. S. Colbourne.
Journal of Applied Bacteriology (Symposium Supplement) JABAA4, p 47S-59S, 1985. 5 fig, 4 tab, 36 ref.

Descriptors: *Water treatment, *Microorganisms, *Materials testing, Microbiological studies, Plastics, Polyvinylchloride, Glass reinforced polyesters, Epoxy resins, Potable water, Drinking water, Water quality, Escherichia coli, Water treatment facilities, Elastomers, Pipes.

Microbial growth problems associated with the use of synthetic materials such as polyvinylchloride, glass reinforced polyester and epoxy resins used in water supply and treatment systems are assessed. Mechanisms for microbial growth in water systems and their adverse effects on drinking water quality are identified. Control measures to mitigate or prevent the growth of organisms such as E. coli are evaluated. Results of a previous experiment in which mean dissolved oxygen difference was used to measure microbial growth are discussed. The relative performance of several elastomeric and plastic materials tested for microorganism growth potential is presented. It is concluded that existing test protocols are adequate to preselect and formulate materials that will not cause microbial growth in water treatment systems. (Michael-PTT)
W87-02210

SPECIFIC DEPOSIT AND MODELS OF HORIZONTAL COUNTER-CURRENT FILTRATION,
Roorkee Univ. (India). Dept. of Civil Engineering.
For primary bibliographic entry see Field 5D.
W87-02355

WATER PURIFICATION BY FLUIDIZED BED TECHNIQUE,
Benin Univ., Benin City (Nigeria).
For primary bibliographic entry see Field 5D.
W87-02356

REMOVAL OF CHLORINATED HYDROCARBONS FROM WATER AND WASTEWATER BY BACTERIAL CELLS ADSORBED TO MAGNETITE,
Queensland Univ., Brisbane (Australia). Dept. of Microbiology.
For primary bibliographic entry see Field 5D.
W87-02361

PHOTODYNAMIC INACTIVATION OF E. COLI BY IMMOBILIZED OR COATED DYES ON INSOLUBLE SUPPORTS,
Perugia Univ. (Italy).
A. Savino, and G. Angeli.
Water Research WATRAG, Vol. 19, No. 12, p 1465-1469, December 1985. 3 fig, 4 tab, 24 ref.

Descriptors: *Escherichia coli, *Photoinactivation, *Oxidation, *Dyes, *Disinfection, Drinking water, Culture media, Aeration, Light exposure, Activated carbon, Disinfection, Adsorption, Methylene blue, Rose bengal, Eosin, Silica gel, Polystyrene resin, Regression analysis.

The photodynamic inactivation of E. coli by immobilized or coated dyes on insoluble supports was studied. Light-exposed and aerated tap water was contaminated with E. coli subjected to dye sensitized photo-oxidation. After various treatment times, the samples were diluted and plated on agar to determine the number of colony forming units. All the light exposed and aerated immobilized dyes (methylene blue, rose bengal and eosin) had an elevated photodynamic action on E. coli. After only a 30 minute treatment time, there was 97.5% inactivation by methylene blue, 92.2% by rose bengal and 81.6% by eosin. Methylene blue coated on activated carbon, silica gel and XAD-2 (polystyrene resin) also had a high photodynamic action with activated carbon providing the best support. When differences in the regression lines of each method were compared, it was found that there was no significant difference between methylene blue immobilized and coated on activated carbon. Sensitized photo-oxidation using methylene blue coated on activated carbon can be used as an alternative for water disinfection, but its effectiveness against other microorganisms must be tested. (Author's abstract)
W87-02389

DENITRIFICATION STUDIES WITH GLYCEROL AS A CARBON SOURCE,
Warsaw Univ. (Poland). Inst. of Environmental Protection Engineering.
A. Grabinska-Loniewska, T. Slomczynski, and Z. Kanska.
Water Research WATRAG, Vol. 19, No. 12, p 1471-1477, December 1985. 7 fig, 2 tab, 27 ref.

Descriptors: *Denitrification, *Glycerol, *Carbon, Anaerobic digestion, Nitrate, Nitrogen, Bacteria, Sludge, Biocenosis.

The use of glycerol as a carbon source for denitrification is discussed in terms of experimental results. A modified Upflow Anaerobic Sludge Blanket (UASB) reactor using a mixed bacterial population containing 600 milligrams of NO3-N and essential biogens was studied. At the most favorable carbon to nitrogen ratio, denitrification efficiency depended on nitrate load as well as cell residence time. Denitrification unit biocenosis was composed of bacteria, fungi and protozoa. The number of denitrifying bacteria per sludge weight unit was constant within the range of nitrate loads studied. (Michael-PTT)
W87-02390

CHLORINE DIOXIDE DISINFECTION OF DRINKING WATER-AN EVALUATION OF A TREATMENT PLANT,
B. Limoni, and B. Teltsch.
Water Research WATRAG, Vol. 19, No. 12, p 1489-1495, December, 1985. 5 fig, 2 tab, 16 ref.

Descriptors: *Chlorine dioxide, *Disinfection, *Drinking water, *Water treatment facilities, Flocculation, Aluminum sulfate, Filtration, Wastewater treatment, Suspended solids, Trihalomethane, Pretreatment of water, Chlorites, Israel.

An Israeli water treatment plant using a two-step process involving flocculation and disinfection with chlorine dioxide was studied to evaluate the effect of chlorine dioxide disinfection on drinking water quality and determine the optimal mode of treatment plant operation. Four operating modes were studied and the optimal mode was identified as one in which an aluminum sulfate flocculant was introduced before the first filtration and chlorine dioxide introduced after the second. Finished water contained a residue of chlorine dioxide, low concentrations of suspended matter and chlorophyll. Trihalomethane concentrations were negligible and bacteriological quality was within national limits. Disinfection of treated water after flocculation and filtration was more effective than that of raw water. This mode also prevented accumulation of high chlorite concentrations leaving a residue of chlorine dioxide. (Author's abstract)
W87-02393

CHEMICAL REGENERATION OF EXHAUSTED ACTIVATED CARBON-II,
Birmingham Univ. (England). Dept. of Civil Engineering.
For primary bibliographic entry see Field 5D.
W87-02397

PREDICTION OF MULTICOMPONENT ADSORPTION EQUILIBRIA IN BACKGROUND MIXTURES OF UNKNOWN COMPOSITION,
Michigan Technological Univ., Houghton. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5D.
W87-02398

VOLATILE OZONIZATION PRODUCTS OF AQUEOUS HUMIC MATERIAL,
Bristol Univ. (England). Organic Geochemistry Unit.
S. D. Killops.
Water Research WATRAG, Vol. 20, No. 2, p 153-165, February, 1986. 6 fig, 4 tab, 45 ref.

Descriptors: *Humic acids, *Water treatment, *Ozonation, *Volatility, Fulvic acids, Polymers, Resins, Gas chromatography, Mass spectrometry, Oxidation, River water.

Humic and fulvic acid samples extracted from river water and two upland waters with high humic content were studied. Aqueous solutions were effectively decolorized by ozonization, but significant chemical alteration of the bulk humic material was not detected. The larger proportion of the material remained as polymeric structures. Less than 10% comprised volatile material which was isolated by XAD-2 resin and subjected to gas chromatography-mass spectrometry analysis to provide some evidence for the formation of carbonyl groups among the humic and fulvic acid volatiles. Ozonization failed to increase the amount of volatile components extracted by XAD-2 resin. These appeared to be species trapped in the macromolecular structure of the humic material. Some

changes, such as increase in n-alkanes and disappearance of alkylnaphthalenes were noted among the volatiles of fulvic and humic acids following ozonization, but volatiles from the upland waters appeared to be more resistant to oxidation. (See also W87-02410) (Author's abstract)
W87-02409

ACTION OF OZONE ON METHYL OCTADEC-9-ENOATE IN POLAR SOLVENTS: A MODEL FOR AQUEOUS OZONIZATION OF ORGANIC COMPOUNDS,
Bristol Univ. (England). Organic Geochemistry Unit.
S. D. Killops.
Water Research WATRAG, Vol. 20, No. 2, p 167-171, February, 1986. 4 fig, 2 tab, 7 ref.

Descriptors: *Ozone, *Methyl octadec-9-enoate, *Water treatment, *Organic compounds, Aldehyde, Carboxylic acid, Oxidation, Solvents, Polarity.

Aqueous ozonization of methyl octadec-9-enoate resulted in formation of aldehyde and carboxylic acid groups at the fragmented C=C bond. High ozone doses increased oxidation of aldehyde to carboxylic acid groups. Methanolic ozonization produced dimethyl acetal groups in preference to aldehyde groups and methylation of carboxylic acid groups was observed. Reaction products analysis was performed by GLC and gas chromatography-mass spectrometry. Results were consistent with radical attack for ozonization in polar solvents. (See also W87-02409) (Author's abstract)
W87-02410

OZONATION OF NAPHTHALENE IN AQUEOUS SOLUTION-I. OZONE CONSUMPTION AND OZONATION PRODUCTS (OZONATION DU NAPHTALENE EN MILIEU AQUEUX-I. CONSOMMATION D'OZONE ET PRODUITS DE REACTION,
Poitiers Univ. (France). Lab. de Chimie de l'Eau et des Nuisances.
For primary bibliographic entry see Field 5D.
W87-02413

OZONATION OF NAPHTHALENE IN AQUEOUS SOLUTION-II. KINETIC STUDIES OF THE INITIAL REACTION STEP, (OZONATION DU NAPHTALENE EN MILIEU AQUEUX - II. ETUDES CINETIQUES DE LA PHASE INITIALE DE LA REACTION),
Poitiers Univ. (France). Lab. de Chimie de l'Eau et des Nuisances.
For primary bibliographic entry see Field 5D.
W87-02414

DEEP BED FILTRATION: A NEW LOOK AT THE BASIC EQUATIONS,
Dundee Univ. (Scotland). Dept. of Civil Engineering.
For primary bibliographic entry see Field 5D.
W87-02415

REMOVAL OF NITRATE IN DRINKING WATER BY ION EXCHANGE-IMPACT ON THE CHEMICAL QUALITY OF TREATED WATER, (DENITRATATION DES EAUS A POTABILISER SUR RESINES ECHANGEUSES D'IONS-IMPACT SUR LA QUALITE CHIMIQUE DE L'EAU TRAITEE),
Poitiers Univ. (France). Lab. de Chimie de l'Eau et des Nuisances.
M. Dore, P. Simon, A. Deguin, and J. Victot.
Water Research WATRAG, Vol. 20, No. 2, p 221-232, February, 1986. 14 fig, 7 tab, 22 ref.

Descriptors: *Nitrate removal, *Drinking water, *Water treatment, *Ion exchange, *Chemical properties, Water quality, Resins, Regeneration, Sodium chloride, Solvents, Herbicides, Aromatic compounds, Nitrosamines, Phenols, Demineralization, Sulfates, Adsorption.

The chemical quality of water treated by a strong base ion exchange resin (IRA 400) regenerated by sodium chloride was studied in two pilot units. The evolution of the constitution synthesis monomers in treated water was studied during the conditioning and exhaustion cycles of the resin. The adsorption isotherms of IRA 400 for aromatic compounds, chlorinated solvents, herbicides and nitrosamines were determined and the concentration of an added phenol was measured during an exhaustion cycle. The study was limited to analysis of N-dimethylnitrosamine since it has been detected in water demineralized by an ion exchange resin. IRA 400 showed good nitrate elimination for raw water at low sulfate concentration, but nitrate selectivity decreased at higher levels. Preliminary conditioning eliminated a great part of the leachable constitution monomers. There was better adsorption of aromatic compounds than small aliphatic molecules. Nitrosamine concentrations in IRA 400 treated water were below detectable limits. The use of IRA 400 resin for denitration of drinking water does not modify the organic characteristics of the treated water. (Michael-PTT)
W87-02416

DEVELOPMENTS OF TOTAL KJELDAHL NITROGEN AND BACTERIAL BIOMASS ALONG A POTABILIZATION LINE, (EVOLUTION DE L'AZOTE KJELDAHL ET DE LA BIOMASSE BACTERIENNE LE LONG D'UNE FILIERE DE TRAITEMENT D'EAU POTABLE),
Montpellier-2 Univ. (France). Lab. d'Hydrologie et d'Hygiene.
M. Albat, B. Baleux, B. Picot, J. M. Philipot, and J. Bontoux.
Water Research WATRAG, Vol. 20, No. 2, p 237-245, February, 1986. 4 fig, 4 tab, 17 ref.

Descriptors: *Kjeldahl procedure, *Nitrogen, *Bacterial analysis, *Water treatment, Paris, France, Monitoring, Rivers, Nitrogen removal, Sedimentation, Adsorption, Sand filters, Carbon filters, Filtration, Ozonation, Chlorination, Disinfection, Fluorescence.

The behavior of total Kjeldahl nitrogen (TKN) was monitored throughout the treatment line at a facility of the Suburban Paris Water Authority. A bacterial count was conducted which separated active from inactive bacteria. Sampling of river water upstream from the waterworks showed low TKN. At the first treatment site, a storage reservoir, bacterial action fluctuated and nitrogen abatement was due to bacterial effects and natural settling of suspended solids on which nitrogenous molecules could be adsorbed. After sand filtration, ammonia nitrogen was not discernable, but there was no effect on organic nitrogen. Granular activated carbon filtration arrested more active than inactive bacteria. Ozonation and chlorination-disinfection occurred at the end of the treatment line. The effect of ozonation is discussed in terms of its ability to prevent formation of bacterial colonies and its effect on the fluorescent color of bacterial cells. (Michael-PTT)
W87-02418

RESTORATION OF GASOLINE-CONTAMINATED HOUSEHOLD WATER SUPPLIES TO DRINKING WATER QUALITY,
Maine Univ. at Orono. Dept. of Civil Engineering.
J. Lowry, and S. Lowry.
IN: The Second Annual Eastern Regional Ground Water Conference, July 16-18, 1985, Portland, Maine. 1985. p 506-521, 7 fig, 3 tab, 12 ref.

Descriptors: *Gasoline, *Drinking water, *Water quality control, *Water treatment, Domestic water, Aeration, Activated carbon, Methyltertiary butyl ether, Volatile organics, Organic carbon, Benzene, Toluene.

A diffused aeration system employing multiple stages in series, was found to be ideally suited to the treatment of gasoline contaminated household water supplies, for contaminated water at 3 sites in Maine. The diffused aeration process is capable of treating water containing several hundred mg/L of total gasoline to drinking water quality. Diffused aeration is more cost effective than granular activated carbon treatment, especially for highly contaminated water supplies. Methyltertiary butyl ether was the controlling compound for the design and operation of the aeration process. It was the most difficult volatile organic carbon to strip, and resulted in aeration volume and energy requirement of approximately twice that required for benzene and toluene. (See also W87-02437) (Lantz-PTT)
W87-02471

INVESTIGATION AND REMEDIATION OF A MINERAL SPIRIT PRODUCT LOSS IN A SHALLOW UNCONFINED AQUIFER,
O'Brien and Gere Engineers, Inc., Syracuse, NY.
J. C. Tomik, C. B. Murphy, and D. Y. Wright.
IN: The Second Annual Eastern Regional Ground Water Conference, July 16-18, 1985, Portland, Maine. 1985. p 522-528, 3 fig, 2 ref.

Descriptors: *Aquifers, *Shallow water, *Oil pollution, *Groundwater pollution, Massachusetts, Volatile organics, Organic compounds, Underground storage, Water analysis, Computer models, Gas chromatography, Photoionization.

A site assessment conducted in conjunction with the sale of a manufacturing facility revealed that a release of oil, as defined in Massachusetts General Laws, Chapter 21E, had occurred. This release was determined based upon the detection of volatile organic compounds and a petroleum substance within three soil test borings. The manufacturing facility currently stores odorless mineral spirits (oms) in two underground 3,000 gallon tanks and stores freon in an aboveground storage tank. Historically, the site was used as a warehouse and the underground tanks were used for storage of diesel fuel. The objectives of subsequent investigations were to (1) determine the type of petroleum materials released, (2) define the source and extent of the product within the soils, and (3) develop a remedial program to ensure expedient and effective recovery of the petroleum product. Analytical techniques including field screening with a photoionization instrument and laboratory gas chromatograph analyses have been demonstrated to be an effective tool to identify the source and type of product loss. Groundwater computer modeling has been useful for designing the type, location and size of the product recovery system. The use of portable activated carbon contactor system provides a convenient and economic method of treatment of the groundwater discharge of a petroleum recovery system. (See also W87-02437) (Lantz-PTT)
W87-02472

IS CURRENT TECHNOLOGY THE ANSWER.
National Water Supply Improvement Association, Springfield, VA.
For primary bibliographic entry see Field 5G.
W87-02476

COLORADO RIVER WATER QUALITY IMPROVEMENT PROGRAM,
Bureau of Reclamation, Denver, CO. Colorado River Water Quality Office.
A. R. Jonez.
IN: Is Current Technology the Answer, Proceedings of the First Biennial Conference of the National Water Supply Improvement Association, June 8-12, 1986, Washington, DC. (1986). p 1-8, 1 fig, 2 tab.

Descriptors: *Colorado River, *Water quality control, *Water treatment, Reclaimed water, Cost analysis, Saline water systems, Industrial wastes, Long-term planning.

Investigations to define the most cost-effective measures for the management of water quality in the Colorado River, will continue as funding permits. Construction of the Grand Valley State Two reclamation project, will soon begin, with construction activities (deep well injection drilling) beginning this winter on Paradox Valley, and reformation of plans continuing on the Las Vegas Wash Unit. USDA onfarm implementation in Grand Valley, Uinta Basin, and other units will proceed as program funding permits. To date, the

Bureau of Reclamation and USDA have reduced the salinity of the Colorado River by 88,800 tons and we have an additional 1.3 million tons to go. As technology changes in the development of powerplant cooling or other beneficial use opportunities, the development potential of specific units will improve. A long-range program is being developed for the next 20-25 years that will implement the most cost-effective units needed to maintain the numeric criteria set for the river system so the Basin States can continue to develop their compact apportioned waters. (See also W87-02476) (Lantz-PTT)
W87-02477

REMOVAL OF ORGANIC CONTAMINANTS FROM GROUNDWATER: STATUS OF EPA DRINKING WATER RESEARCH PROGRAM,
Environmental Protection Agency, Washington, DC. Office of Research and Development.
F. T. Mayo, C. A. Fronk, and R. M. Clark.
IN: Is Current Technology the Answer, Proceedings of the First Biennial Conference of the National Water Supply Improvement Association, June 8-12, 1986, Washington, DC. (1986). p 10-28, 3 tab, 13 ref.

Descriptors: *Organic compounds, *Groundwater pollution, *Drinking water, *Water treatment, Legislation, Field tests, Carbon, Adsorption, Ozonation, Ultraviolet radiation, Reverse osmosis, Volatile organics, Pesticides, Polychlorinated biphenyls, Alkenes, Aromatic compounds.

The Drinking Water Research Division (DWRD) of the EPA is responsible for evaluating the various types of technologies that might be used to meet the maximum contaminant levels promulgated under the Safe Drinking Water Act. Because the source water for many utilities in the United States is groundwater, DWRD is especially concerned about conducting bench-, pilot- and field-scale studies on technologies that effectively treat groundwater. DWRD has research projects examining carbon adsorption and air stripping at the field-scale level as well as ozone oxidation, ultraviolet light, and reverse osmosis on the bench and pilot scales. Carbon adsorption appears to provide removal for a wide range of organics whereas conventional treatment is revealed as a poor treatment for many volatile organics, pesticides, polychlorinated biphenyls, etc. Packed tower aeration manifests itself as an excellent technology for volatile organic compounds and may have application for a limited number of pesticides. Ozone oxidation comes to light as a good treatment technology for certain classes of organics such as simple alkenes and aromatics, as well as certain similar, but more complex organic structures. In regard to reverse osmosis, although only a few organics have been subjected to long-term testing, promising removals for several low molecular weight organics can be seen. (See also W87-02476) (Lantz-PTT)
W87-02478

REVIEW OF ELECTRODIALYSIS,
Ionics, Inc., Watertown, MA.
For primary bibliographic entry see Field 3A.
W87-02481

POTABLE WATER PRODUCTION WITH LOW-PRESSURE TFC REVERSE OSMOSIS MEMBRANE ELEMENTS,
UOP, Inc., San Diego, CA. Fluid Systems Div.
H. C. Chu, R. D. Chmielewski, and W. G. Light.
IN: Is Current Technology the Answer, Proceedings of the First Biennial Conference of the National Water Supply Improvement Association, June 8-12, 1986, Washington, DC. (1986). p 178-209, 8 fig, 3 tab, 9 ref.

Descriptors: *Potable water, *Reverse osmosis, *Membrane processes, *Thin-film membranes, Cost analysis, Arid regions, Brackish water, Desalination, Dissolved solids, San Diego, California, Florida, Water treatment, Mathematical analysis, Salinity.

The worsening quality of raw water sources in arid regions is necessitating the upgrading of water treatment facilities for municipal supplies. Of the candidate treatment processes, reverse osmosis (RO) has proven to be a reliable and effective method for producing potable water. To reduce capital and operation costs, spiral-wound RO membrane elements, capable of producing potable water from brackish water when operated at low pressure (200 psi net), have been developed. The elements contain a high flux, thin-film composite (TFC) membrane and are fabricated in a closed-coupled configuration to maximize productivity. Results are presented in this paper of two case studies for producing potable water at low pressure from brackish water containing 4-5 g/L total dissolved solids. The first study was performed using water from a brackish well in San Diego, California. The work for the second case study was performed during the winter of 1985 for the Englewood Water District in Florida as part of a program to quality products for a 1 MGD expansion of a water treatment system. Performance characteristics for low pressure elements are given in terms of water and salt mass transfer coefficients. A description of the RO systems and analyses of the feed and product water compositions are given. Based on actual data, flux decline slopes for predicting performance are determined for the element. The importance of maintaining rejection at economical recovery for the long-term production of potable water is discussed. (See also W87-02476) (Lantz-PTT)
W87-02485

CASE FOR AN ALL PURPOSE BRACKISH WATER MEMBRANE,
Du Pont de Nemours (E.I.) and Co., Wilmington, DE.
I. Moch.
IN: Is Current Technology the Answer, Proceedings of the First Biennial Conference of the National Water Supply Improvement Association, June 8-12, 1986, Washington, DC. (1986). p 268-287, 7 fig, 1 tab.

Descriptors: *Brackish waters, *Membrane processes, *Water treatment, Case studies, Reverse osmosis, Water quality, Flow profiles, Membranes, Cost analysis, Dissolved solids, Atmospheric pressure, Temperature.

In recent years there has been a great deal of research activity by membrane suppliers aimed at developing reverse osmosis (RO) devices which have applications over a wide range of brackish waters. These efforts have been very successful in producing units which maintain uniform water flow and quality, at low cost to the customer, under both ideal and adverse conditions. It has been found that an aramid polymer cast onto flat polyester substrates, and formed into a spiral wound configuration, has a high value-in-use to a wide variety of applications. To achieve this worth in a given project, a number of interrelated technical and economic variables must be carefully balanced. This paper studies a number of these variables by analyzing the operating and capital costs for a battery limit 500,000 gpd RO plant. Variables examined include total dissolved solids (over a range of 200 to 15,000 mg/L), applied pressures (100 to 600 psig), system conversions (50 to 85%), feed pH (5.5 to 8.5) and feed temperatures (59 to 95 F). This study stresses the importance to the end-user and to the consulting engineer, of the need for specifications that will permit the full use of the capabilities available in a desalting membrane. The bid documents should allow water treatment companies the freedom necessary to design the lowest cost plant while consistently supplying the desired water quality and quantity. (See also W87-02476) (Author's abstract)
W87-02488

DESIGN AND ECONOMIC ANALYSIS OF REVERSE OSMOSIS SYSTEMS USING APPLICATION SOFTWARE AND MICROCOMPUTERS,
DSS Engineers, Inc., Fort Lauderdale, FL.
O. J. Morin.
IN: Is Current Technology the Answer, Proceedings of the First Biennial Conference of the National Water Supply Improvement Association, June 8-12, 1986, Washington, DC. (1986). p 288-307, 13 fig, 3 tab.

Descriptors: *Economic aspects, *Reverse osmosis, *Design criteria, Computer programs, Brackish water, Reclaimed water, Langelier Index, Osmotic pressure, Membranes, Cost analysis, Operating costs.

This paper presents an overview of the use of application software for the design and analysis of brackish water reverse osmosis (RO) units. The worksheets developed can be used for: (a) Water Analysis - to calculate such items as Langelier Index, osmotic pressure, ion product solubilities, etc., and determine maximum conversion rate; (b) Plant Design - to determine process conditions such as operating pressure, flowrates, etc., and the number of membranes required; and (c) Cost Estimating - used to determine equipment capital and plant operating costs. This type of software can be used to evaluate the performance of the RO facility after it has gone into operation. All that is necessary is a data acquisition system to interface with the software. Input information from the plant operation can then be manipulated to monitor and track operation and performance of the plant. Results of the operation can then be presented. (See also W87-02476) (Lantz-PTT)
W87-02489

RECOVERY OF AGRICULTURAL DRAINAGE WATER USING DESALINATION TECHNOLOGY,
Bechtel National, Inc., Washington, DC.
L. Awerbuch, V. van der Mast, M. Weekes, S. Levine, and B. Smith.
IN: Is Current Technology the Answer, Proceedings of the First Biennial Conference of the National Water Supply Improvement Association, June 8-12, 1986, Washington, DC. (1986). p 310-332, 8 fig, 4 tab, 2 ref.

Descriptors: *Agricultural runoff, *Reclaimed water, *Desalination, Evaporation, Reverse osmosis, Los Banos, California, Selenium, Water reuse, Pretreatment of water, Filtration, Chlorination, Ion exchange, Electrodialysis, Distillation, Solar ponds.

Concentration of agricultural drainage water by commercially available reverse osmosis (RO) and vapor compression evaporation (VCE) technologies has been successfully proven at the Los Banos, California, demonstration facility. Excellent selenium rejection was demonstrated in the RO and VCE units. Product water can be obtained for reuse. This paper describes the overall test facilities at Los Banos. The facility consisted of the following: (1) pretreatment technologies: clarification, filtration, chlorination, acidification, ion exchange, and scale inhibitor addition, (2) RO technologies: various types of RO modules, low, medium and high pressure membranes are installed and operational; (3) electrodialysis system (EDR); and (4) solar pond and binary power process. The following were the advantages: greatly simplified pretreatment, simple operation, enhanced reliability, small final disposal volume, and enhancement product purity. Additional improvements being developed at the Los Banos Test Facility: (1) Solar ponds where the energy consumption for the drainage water concentration can be greatly reduced by the use of solar ponds. Pilot studies with solar ponds and a binary power system are presently underway at Los Banos; (2) Use of low temperature multieffect distillation, whereby the overall process efficiency can be further enhanced for brine concentration; and (3) Filtration tests are underway to simplify the solids removal from agricultural drainage water feed. The clarifier may be eliminated while maintaining low silt density index values. (See also W87-02476) (Lantz-PTT)
W87-02490

YUMA DESALTING PLANT - A STATUS REPORT,
Bureau of Reclamation, Yuma, AZ. Yuma Projects Office.
For primary bibliographic entry see Field 3A.
W87-02494

FINANCING MUNICIPAL WATER SUPPLIES IN THE 1990'S,
Congressional Budget Office, Washington, DC.
K. I. Rubin.
IN: Is Current Technology the Answer, Proceedings of the First Biennial Conference of the National Water Supply Improvement Association, June 8-12, 1986, Washington, DC. (1986). p 424-436.

Descriptors: *Municipal water, *Financing, *Water supply, Economic aspects, Utilities, Public policy, Water management, Capital costs.

Water purveyors have a long history of providing the public with good quality water at reasonable prices. Moreover, unlike many other infrastructure areas, water utilities have financed their operations with little reliance on intergovernmental handouts. This paper demonstrates that most water utilities should be able to continue this long tradition well into the future. Although there is little evidence to support a coming water 'crisis', water rates, which are now low by almost any standard, will almost certainly have to increase through the 1990s to replace outdated capital structures provide new ones to serve the needs of growing populations. The level of financing necessary to support such a program appears manageable for the majority of communities. It appears likely, however, that all communities will have to continue to rely on the many local capital formation and management opportunities including more and creative use of capital markets, demand management and other non-structural alternatives to building new facilities, and more sophisticated capital planning. (See also W87-02476) (Lantz-PTT)
W87-02495

ACTIVATED CARBON ADSORPTION OF LOW CONCENTRATION ORGANIC PESTICIDES IN WATER,
Hawaii Univ. at Manoa, Honolulu. Dept. of Civil Engineering.
G. L. Dugan, H. K. Gee, K. M. Oshiro, and L. S. Lau.
IN: Proceedings of the Fifth National Symposium and Exposition on Aquifer Restoration and Ground Water Monitoring, May 21-24, 1985, The Fawcett Center, Columbus, Ohio. 1985. p 449-461, 3 fig, 2 tab, 4 ref.

Descriptors: *Activated carbon, *Pesticides, *Organic compounds, *Water pollution treatment, Ethylene dibromide, Dibromochloropropane, Bromides, Load distribution.

A series of thirty separate experimental laboratory bench-scale runs were conducted in which concentrations of ethylene dibromide (EDB) and dibromochloropropane (DBCP) in water, ranging from 2,170 to 10,000 parts per trillion (ppt), were treated by passing various quantities through both standard and fine-grained Calgon and Darco granulated activated carbon (GAC). The results of the experiments indicate that Calgon is more efficient than Darco in removing EDb and DBCP, fine-grained GACs are more efficient than standard GACs, EDB is removed more efficiently than DBCP, and the pesticide removal efficiency of the GAC--based on fine-grained Calgon--decreases significantly when a mixture of EDB and DBCP is passed through the same GAC. At single concentrations of EDB, no detectable concentrations (at the 10-ppt level) were noted when the maximum flow-through GAC loading rates were 307 gal/lb/day (< or = 1.78 ml/g/min). Based on extrapolated results, the GAC requirement for 100 ppt pesticide concentrations is estimated to be approximately 1.0/1.0 mil gal. (See also W87-02497) (Author's abstract)
W87-02524

ONE MGD ION EXCHANGE PLANT FOR REMOVAL OF NITRATE FROM WELL WATER,
Municipal Environmental Research Lab., Cincinnati, OH. Drinking Water Research Div.
R. P. Lauch, and G. A. Guter.
IN: Proceedings of the Fifth National Symposium and Exposition on Aquifer Restoration and Ground Water Monitoring, May 21-24, 1985, The Fawcett Center, Columbus, Ohio. 1985. p 546-570, 9 fig, 9 tab, 4 ref.

Descriptors: *Ion exchange, *Water treatment facilities, *Nitrates, *Well water, McFarland, California, Brine, Potable water, Resins, Cost analysis.

A full scale 1 mgd demonstration plant, using ion exchange, for removal of nitrate from well water was built at McFarland, California. The plant has been performing satisfactorily in the semi-automatic mode since October 1983. Full automation of the plant was completed in June 1984. State of California requirements of reducing nitrate levels below 10 mg/L NO3-N and eliminating brine from the product water have been met. Total costs for the plant, including capital and operation and maintenance were 24.2 cents/ 1000 gal. Research is continuing at McFarland on nitrate selective resins, regenerant re-use, monitoring and brine disposal, in an effort to further improve the process and reduce costs. (See also W87-02497) (Lantz-PTT)
W87-02533

5G. Water Quality Control

BIOLOGICAL CONTROL OF EXCESSIVE PHYTOPLANKTON GROWTH AND THE ENHANCEMENT OF AQUACULTURAL PRODUCTION,
California Univ., Santa Barbara. Dept. of Biological Sciences.
D. W. Smith.
Canadian Journal of Fisheries and Aquatic Sciences CJFSBX, Vol. 42, No. 12, p 1940-1945, December 1985. 4 fig, 2 tab, 43 ref.

Descriptors: *Silver carp, *Phytoplankton, *Biomass, *Aquaculture, *Catfish, *Zooplankton, *Biological control, Refuges, Filter-feeders, Fish farming.

A method is proposed to control phytoplankton biomass in aquacultural ponds, using both zooplankton and filter-feeding silver carp (Hypophthalmichthys molitrix). The technique maintains coexistence of zooplankton and filter-feeding fish by excluding the fish from part of the water column. Zooplankton, which feed on the smaller algal species, and silver carp, which feed on large algae and zooplankton, together can consume all sizes of phytoplankton, thus controlling algal biomass. This technique was tested in 1000-liter tanks, some containing channel catfish (Ictalurus punctatus) along, some both catfish and silver carp, and others catfish and silver carp with a zooplankton refuge. The refuge permitted coexistence of high densities of large zooplankters with the filter-feeding fish. This combination of filter-feeders reduced algal biomass by as much as 99%, increased phytoplankton diversity, and showed a trend toward improved silver carp growth compared with treatments without a refuge. The proposed technique could be applied to both intensive and extensive aquacultural systems. (Author's abstract)
W87-01813

ALDICARB STUDIES IN GROUND WATERS FROM FLORIDA CITRUS GROVES AND THEIR RELATION TO GROUND-WATER PROTECTION,
Florida Inst. of Tech., Melbourne. Dept. of Environmental Sciences and Engineering.
For primary bibliographic entry see Field 5B.
W87-01871

PREDICTING IMPACTS FROM WATER CONSERVATION AND ENERGY DEVELOPMENT ON THE SALTON SEA, CALIFORNIA,
California Univ., Los Angeles. Office of Environmental Science and Engineering.
For primary bibliographic entry see Field 6G.
W87-01897

WATERFALL REAERATION IN THE PASSAIC RIVER,
Cook Coll., New Brunswick, NJ. Dept. of Environmental Science.
For primary bibliographic entry see Field 5B.
W87-01921

CONTROLLED AGRICULTURAL DRAINAGE TO MAINTAIN WATER QUALITY,
North Carolina State Univ. at Raleigh. Dept. of Soil Science.
J. W. Gilliam, and R. W. Skaggs.
Journal of Irrigation and Drainage Engineering (ASCE) JIDEDH, Vol. 112, No. 3, p 254-263, August 1986. 2 fig, 4 tab, 13 ref.

Descriptors: *Controlled drainage, *Agricultural runoff, *Agricultural hydrology, *Water quality management, *Drainage engineering, Drainage, Land clearing, Drainage systems, Water quality, Engineering, Runoff, Runoff rates, Nitrogen, Phosphorus.

The effects of land clearing and drainage as well as effect of drainage system design and management upon hydrologic and water quality parameters were determined. The most dramatic effect of agricultural land development on hydrology is the 2-3 fold increase in peak runoff rates. However, there is little effect upon total water efflux. Land clearing significantly increases N and P efflux in drainage water; the magnitude of the increase depends on soil type. Design of the drainage system, particularly with regard to drain spacing and intensity of surface drainage, can have a large influence upon the proportion of outflow that occurs via surface runoff which is fast and that which leaves the field more slowly via subsurface flow. Improvement of subsurface drainage can result in a 10-fold increase in the NO3-N efflux from some soils. However, the increase in NO3-N efflux with improved drainage can be partially offset by utilizing controlled drainage which reduces NO3-N efflux. Controlled drainage can result in an increase of P loss in drainage water. (Author's abstract)
W87-01954

PREDICTING EC FOR DRAINAGE WATER MANAGEMENT,
Nevada Univ., Reno. Dept. of Plant, Soil and Water Science.
P.-S. Tsui, and J. C. Guitjens.
Journal of Irrigation and Drainage Engineering (ASCE) JIDEDH, Vol. 112, No. 3, p 274-281, August 1986. 2 fig, 3 tab, 18 ref.

Descriptors: *Predicting, *Conductivity, *Drainage water, *Water quality management, *Model studies, Drainage, Subsurface drains, Drains, Time series analysis, Forecasting, Water management, Resources management.

In 1982, 405 measurements of the subsurface drainage water quality parameter electrical conductivity (EC) in dS/m were collected. These data were obtained from 15 subsurface drains on 9.3 ha of irrigated agricultural land at Fallon, Nevada. The temporal and spatial variabilities of EC were studied using time series concepts. Autocorrelation functions (ACF) were used to evaluate the magnitude of temporal and spatial variations of EC. Results suggest that an 11-week period is the maximum time interval for sampling and that the sampling spatial interval of 36.6 m is too large. Autoregressive integrated moving average (ARIMA) models for both temporal and spatial structures were established through the Box-Jenkins time-domain modeling process. The degree of uncertainty of the forecasts was tested using after-the-fact forecast procedures. These models can be used for various purposes such as forecasting future values and determining the transfer function, providing a way to relate water management plans to water quality control. (Author's abstract)
W87-01956

STUDY OF CURRENT UNDERGROUND INJECTION CONTROL REGULATIONS AND PRACTICES IN ILLINOIS,
Illinois State Water Survey Div., Champaign.
A. P. Visocky, J. S. Nealon, R. D. Brower, I. G. Krapac, and B. R. Hensel.

Ground Water Monitoring Review, Vol. 6, No. 3, p 59-63, Summer 1986. 2 fig, 2 tab, 2 ref.

Descriptors: *Regulations, *Injection wells, *Illinois, *Underground waste disposal, *Acids, Geology, Illinois Department of Energy and Natural Resources, Confining zones, Chemical analysis, Testing, Monitoring, Data evaluation.

In 1984, the Illinois Department of Energy and Natural Resources was required to assess the regulations and practices of the Illinois Underground Injection Control Program as it relates to Class I hazardous waste disposal. In 1984, approximately 300 million gallons of industrial wastes were disposed of in the nine injection wells in the state; acids were the most common industrial wastes disposed of, with water making up 70-95% of the wastes by volume. The geologic environment, consisting of the unit accepting the waste and confining units lying above and below, has the capacity to accept the waste, to retain it, and to protect all underground sources of drinking water in the state. The geology of Illinois is relatively simple and includes disposal zones and associated confining units suitable for deep-well injection across the central two-thirds of the state. The regulatory structure for Class I injection wells generally is adequate in concept and scope to ensure containment of injected wastes and to safeguard the state's underground drinking water sources. Portions of the regulatory practices need to be updated and strengthened, including waste sampling protocols, chemical analysis of collected waste samples, and evaluation of injection well testing and monitoring data. (Rochester-PTT)
W87-02055

LABORATORY STUDY OF ELECTROMIGRATION AS A POSSIBLE FIELD TECHNIQUE FOR THE REMOVAL OF CONTAMINANTS FROM GROUND WATER,
D. D. Runnells, and J. L. Larson.
Ground Water Monitoring Review, Vol. 6, No. 3, p 85-91, Summer 1986. 5 fig, 3 tab, 21 ref.

Descriptors: *Groundwater pollution, *Cleanup, *Aquifers, *Copper, *Electromigration, Mineral exploration, Groundwater chemistry, Ions, Cost analysis, Electrolysis, Hydrogen ion concentration, Copper sulfate, Freezing.

A method of removing dissolved contaminants from groundwater by emplacing electrodes in the aquifer was studied using laboratory columns of pure silica quartz silty sand saturated with solutions of CuSO4 and Cu-contaminated groundwater. The procedure resembles a method employed in the Soviet Union that is commonly used for exploration for deposits of metallic minerals. Quick-freezing was used here to obtain the distribution of the ions within the columns as a function of time and space. With up to 2.5 volts and currents of a few tens of microamps, more than 50% of the dissolved copper was removed from the interstitial fluid in porous columns in a period of 5 days. Current efficiencies ranged from <5->80%, depending on such factors as length of time of electrolysis, pH, concentration of Cu, and the presence of other ions. Further studies are needed to evaluate the efficiency and economics of this technique, but in theory the method should be useful for removing any charged species in groundwater, including some organics. (Author's abstract)
W87-02060

SUITABILITY OF POLYVINYL CHLORIDE WELL CASINGS FOR MONITORING MUNITIONS IN GROUND WATER,
Cold Regions Research and Engineering Lab., Hanover, NH.
L. V. Parker, and T. F. Jenkins.
Ground Water Monitoring Review, Vol. 6, No. 3, p 92-98, Summer 1986. 3 tab, 27 ref. USATHAMA Project 82-D-8.

Descriptors: *TNT, *RDX, *HMX, *DNT, *Polyvinyl chloride, *Well casings, *Monitoring, *Biodegradation, *Munitions, Groundwater pollution, Hydrogen ion concentration, Salinity, Dissolved oxygen, Chromatography.

Samples of polyvinyl chloride (PVC) well casings used for groundwater monitoring were placed in contact with low concentrations of aqueous solutions of the following explosives and related compounds: 2,4,6-trinitrotoluene (TNT), hexahydro-1,3,5-trinitro- 1,3,5-triazine (RDX), octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX), and 2,4-dinitrotolune (DNT, a contaminant in TNT manufacture). The casings, which varied in schedule, diameter, or manufacturer, were exposed for 80 days. There was more loss of TNT and HMX with the PVC casing than with the glass controls, but the amount lost was, for the most part, equivalent among different types. A second experiment was performed to determine if these losses were due to sorption or if biodegradation was involved. Several different groundwater conditions were simulated by varying salinity, initial pH, and dissolved oxygen content. The only case where there was an increased loss of any substances due to the presence of PVC casing was with the TNT solution under non-sterile conditions. The extent was small, however, considering the length of the equilibration period. Among several samples of PVC casing leached with groundwater for 80 days, no detectable interferences were found by reversed-phase high performance liquid chromatography analysis. It is concluded that PVC well casings are suitable for monitoring groundwater for the presence of these munitions. (Rochester-PTT)
W87-02061

FEDERAL EVALUATION OF STRIPMINE RECLAMATION,
Environmental Protection Agency, Philadelphia, PA. Region III.
For primary bibliographic entry see Field 5E.
W87-02067

IDENTIFICATION OF WATER QUALITY DIFFERENCES IN NEVADA THROUGH INDEX APPLICATION,
Nevada Univ., Reno. Dept. of Plant, Soil and Water Science.
W. W. Miller, H. M. Joung, C. N. Mahannah, and J. R. Garrett.
Journal of Environmental Quality JEVQAA, Vol. 15, No. 3, p 265-272, July-September 1986. 5 fig, 4 tab, 27 ref.

Descriptors: *Water quality, *Nevada, *River basins, *Statistical analysis, *Data interpretation, On-site data collection, Mathematical equations, Water quality standards, Data acquisition, Water pollution.

Water quality indices can be used for preliminary data screening and identification of geographic areas, chronological periods and possible source and cause of water quality changes for the assessment of water quality changes and application of uniform control standards. This study demonstrates the use and application of a water quality index for several Nevada river basins. An existing water quality index is applied to historic data from control points and adjacent monitoring stations. Index rating characterized changes in water quality due to seasonal variations and geographic locations. Application of the index also identified average annual and single value control criteria violations in terms of the parameter and degree of violation. Frequency and magnitude of impact on overall water quality was also identified. Use of water quality indices can provide a valuable tool in responding to legislative water quality management strategies. (Michael-PTT)
W87-02091

SCREENING MODEL FOR DEVELOPMENT AND EVALUATION OF ACID RAIN ABATEMENT STRATEGIES,
Waterloo Univ. (Ontario). Dept. of Civil Engineering.
E. A. McBean, J. H. Ellis, and M. Fortin.
Journal of Environmental Management JEVMA, Vol. 21, No. 4, p 287-299, December 1985. 3 fig, 8 tab, 4 ref.

Descriptors: *Acid rain, *Computer models, *Water pollution control, Cost analysis, Deposition, Sulfur dioxide, Decision making, Linear programming.

A linear programming computer model can be used to develop and evaluate cost effective acid rain abatement strategies. Input data for the model include emission levels and sources of pollution, emission control costs and receptor deposition levels. Acid rain abatement strategy is formulated for eastern North America. Applications of the model for evaluation of alternative abatement strategies are also described. (Michael-PTT)
W87-02111

REMOVAL OF HIGHWAY CONTAMINANTS BY ROADSIDE SWALES,
Y. A. Yousef, M. P. Wanielista, and H. H. Harper.
Transportation Research Record, Vol. 1017, p 62-68, 1985. 2 fig, 6 tab, 4 ref.

Descriptors: *Swales, *Contaminants, *Highway contaminants, *Florida, Pollution, Heavy metals, Highway runoff.

Removal of highway contaminants by roadside swales was investigated at the Maitland and EPCOT Interchanges with Interstate 4 (I-4) in Orange county, Florida. Runoff samples were collected for 8 months to compare the highway runoff with runoff that passed through a grassy swale. A controlled water flow from adjacent detention/retention ponds was dosed with nitrogen, phosphorus,and heavy metals to produce concentrations typical of highway runoff. The mixture was allowed to flow for a period of 3 to 5.5 hours over selected areas of adjacent roadside swales. Periodic grab samples were collected and were analyzed to determine concentrations and mass removal rates for various pollutants under several values of flow rates and experimental conditions. Removal efficiencies for dissolved heavy metals appeared to be higher than for nitrogen and phosphorus. Pollutants may be retained in swale areas by sorption, precipitation, coprecipitation and biological uptake processes. Occassional increases in concentration of highway contaminants were observed at intermediate stations. Mass removal of heavy metals, nitrogen, and phosphorus were directly related to infiltration losses and on-site storage. (Author's abstract)
W87-02184

BASE NEUTRALIZING CAPACITY OF SEDIMENTS FROM AN ACIDIC LAKE,
Booth Aquatic Research Group, Inc., Toronto (Ontario).
For primary bibliographic entry see Field 2H.
W87-02190

MODELING ENTERIC BACTERIAL DIE-OFF: A REVIEW,
Oregon State Univ., Corvallis. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 5B.
W87-02195

SIGNIFICANCE OF WATER MANAGEMENT IN RELATION TO PUBLIC AND ENVIRONMENTAL HEALTH,
World Health Organization, Copenhagen (Denmark). Regional Office for Europe.
W. Lewis.
Journal of Applied Bacteriology (Symposium Supplement) JABAA4, p 1S-13S, 1985. 2 tab, 21 ref.

Descriptors: *Water quality control, *Water policy, *Water supply, *Drinking water, *Water quality, *Public health, Europe, Mediterranean Sea, Water pollution effects, Water pollution sources, Water pollution prevention Infection, Water quality standards, Contamination, Groundwater pollution, United Nations.

The relationship between water quality management and public and environmental health is discussed in relation to the objectives of the United Nations' International Drinking Water Supply and Sanitation Decade. European water quality issues

are examined with particular emphasis on the health problems caused by pollution of the Mediterranean Sea. Global water pollution and quality control problems, including waterborne virus infections, groundwater contamination, international variations in drinking water quality standards and microbial contamination of drinking water supplies are also examined. (Michael-PTT)
W87-02206

OCCURRENCE IN WATER OF VIRUSES OF PUBLIC HEALTH SIGNIFICANCE,
Welsh Water Authority, Powys.
For primary bibliographic entry see Field 5B.
W87-02209

POLLUTION OF FRESHWATER AND ESTUARIES,
North West Water Authority, Warrington (England).
For primary bibliographic entry see Field 5A.
W87-02212

MICROBIOLOGICAL IMPLICATIONS IN EUROPEAN COMMUNITY DIRECTIVES RELATED TO THE WATER CYCLE,
Water Research Centre, Medmenham (England). Medmenham Lab.
E. B. Pike, and J. W. Ridgway.
Journal of Applied Bacteriology (Symposium Supplement) JABAA4, p 105S-126S, 1985. 2 fig, 3 tab, 64 ref.

Descriptors: *Microorganisms, *Water pollution, *Legislation, *European Community, *England, Aquatic environment, Water supply, Recreation, Swimming, Drinking water, Bacterial analysis, Biodegradation, Shellfish, Sludge utilization, Agriculture, Sludge disposal, Land disposal, Detergents, Bottled water.

The efficacy and reasonableness of European Community directives related to the aquatic environment, water supply management, marine waters used for swimming and shellfish culture, biodegradation of chemicals and detergents and the agricultural use of treated sludge are discussed in terms of water quality control policies and practices in England. Directives related to aquatic environmental quality are assessed in relation to aquatic microbiological considerations, including the use of marker organisms such as fecal indicator bacteria in the promulgation of water quality standards. Directives related to water supply (drinking water, bottled water and surface water) management are evaluated in light of English water supply protection standards and methods. Issues related to the application of standard tests to assess biodegradability of chemicals and detergents are examined. A proposed directive on limiting agricultural utilization of sludge is critically evaluated in relation to unique local conditions that might mitigate the risks of sludge use in certain areas. (Michael-PTT)
W87-02215

MICROBIAL QUALITY OF WATER IN INTENSIVE FISH REARING,
Ministry of Agriculture, Fisheries and Food, Weymouth (England). Fish Diseases Lab.
For primary bibliographic entry see Field 5C.
W87-02220

NIAGARA LABYRINTH-THE HUMAN ECOLOGY OF PRODUCING ORGANOCHLORINE CHEMICALS,
Department of Fisheries and Oceans, Ottawa (Ontario). Chemical Hazards Div.
M. Gilbertson.
Canadian Journal of Fisheries and Aquatic Sciences CJFSBX, Vol. 42, No. 10, p 1681-1692, October 1985. 39 ref.

Descriptors: *Niagra River, *Great Lakes,. *Organochlorine compounds, *Great Lakes Water Quality Agreement, Human ecology, Canada, Toxins, Lake Ontario, Epidemiology, Population exposure, Polychlorinated biphenyls, Water pollution, International agreements, Contamination.

The effectiveness of the 1978 Great Lakes Water Quality Agreement between Canada and the U.S. is analyzed in relation to investigation and control of persistent toxic substances. Human ecology and critical pathway analyses are used to review the present and historic situations of Lake Ontario and the Niagra River and to compare them with the intent of the Agreement. The concept of critical subpopulations is explored as it relates to study requirements for human and animal exposure to toxic chemicals found in the Great Lakes basin. An apparent conflict between Annex 1 and Annex 12 of the Agreement regarding release of persistent toxic substances is identified and a draft list of chemicals that should be subject to 'zero discharge' limitations is proposed. Issues related to the identification of toxic substances, particularly polychlorinated biphenyls, institutional reactions to perceived contamination threats, integration of institutional, national and international responses to water pollution problems and the importance of international cooperation in investigating and resolving transboundary pollution problems are reviewed. Several recommendations on clarifying and improving the effectiveness of the Agreement are presented. (Michael-PTT)
W87-02250

ALTERNATE SEWERS-NO LONGER ALTERNATE,
K. A. Godfrey, Jr.
Civil Engineering, Vol. 56, No. 8, p 66-69, August 1986. 4 fig.

Descriptors: *Sewer systems, Technology, Septic tanks, Pumps, Pipes.

Case histories of the application of four alternate sanitary sewer technologies, including a grinder-pump pressure system, septic tank effluent pumping, a vacuum sewer system and a small diameter, pump-assisted system are presented. The reliability and maintainability of each technology is also examined. This examination concludes that these four technologies are now reliable enough to 'fly' on their own, without federal or state subsidy. In a surprising number of cases, an alternate system was chosen even where no federal grant or loan was available, because it was least costly. The major obstacle to wider use appears to be that consulting firms and state environmental agencies are unfamiliar with them. A state's environmental agency typically is required to approve a new municipal sewer system, and consulting engineering firms design most of them. Most organization is both groups reportedly are not familiar with alternate sewers. (Lantz-PTT)
W87-02264

MODELING THE EFFECTS OF ACID DEPOSITION: ESTIMATION OF LONG-TERM WATER QUALITY RESPONSES IN A SMALL FORESTED CATCHMENT,
Virginia Univ., Charlottesville. Dept. of Environmental Sciences.
For primary bibliographic entry see Field 5C.
W87-02271

RISK MANAGEMENT OF GROUNDWATER CONTAMINATION IN A MULTIOBJECTIVE FRAMEWORK,
Bell Communications Research, Inc., Holmdel, NJ.
J. R. Kaunas, and Y. Y. Haimes.
Water Resources Research WRERAO, Vol. 21, No. 11, p 1721-1730, November 1985. 3 fig, 2 tab, 33 ref. DOI Contract 4-FG-93-00090.

Descriptors: *Risk analysis, *Groundwater pollution, *Aquifers, Contamination, Regression analysis, Economic evaluation, Industrial wastes, Simulation, Simulation analysis, Accidents, Stochastic process, Water policy, Long-term planning.

The application of risk analysis to address uncertainty in groundwater contamination from industrial chemical spills is evaluated through case study of a hypothetical factory and two water supply wells. Spill control technologies must achieve three objectives: minimize contamination prevention costs; minimize the time in which a maximum contamination level (MCL) is exceeded; and, minimize the sensitivity of MCL exceedance to uncertainties in aquifer dispersivity. Stochastic time series simulation of spills yields sample values of MCL exceedance for values of investment decision variables and dispersivity. Regression analysis enables calculation of a continuous function that relates the contamination time objective to investments and dispersivity. A risk dispersion index method (RDIM) that incorporates the surrogate worth trade-off method is used to compute the third objective. Simulations assume that the aquifer is in a steady state and behaves linearly. The concentration impulse response for a single spill is computed with a mass transport model. The well solute concentration over time is the basis for calculating the exceedance ratio. To obtain credible values for this, several simulations covering a 20-year planning window are performed for each policy option. (Author's abstract)
W87-02286

COMMERCIAL FISH CATCHES AS AN INDEX OF LAKE EUTROPHICATION,
Instytut Rybactwa Srodladowego, Olsztyn-Kortowo (Poland).
For primary bibliographic entry see Field 2H.
W87-02335

PILOT PLANT STUDY ON WATER QUALITY CHANGES DURING GROUNDWATER RECHARGE,
Ministerie van Volksgezondheid en Milieuhygiene, Leidschendam (Netherlands).
For primary bibliographic entry see Field 5E.
W87-02358

EFFECTS OF HYPOLIMNETIC AERATION ON IRON-PHOSPHORUS INTERACTIONS,
York Univ. (England). Dept. of Biology.
D. J. McQueen, D. R. S. Lean, and M. N. Charlton.
Water Research WATRAG, Vol. 20, No. 9, p 1129-1135, September 1986. 6 fig, 3 tab, 32 ref.

Descriptors: *Hypolimnion, *Aeration, *Iron, *Phosphorus, *Path of pollutants, *Fate of pollutants, *Chemical reactions, Sedimentation, Precipitation, Seasonal variation, Chemical analysis, Sediments, Oxygen.

Two circular enclosures (8 m dia x 14 m deep) were used to monitor rates of phosphorus sedimentation and regeneration in the presence of oxygenated and anoxic hypolimnetic water, and under conditions of low and high iron concentrations. These manipulations showed that during spring turnover, sedimentation of soluble reactive phosphorus (SRP-P) was greater in the enclosure that received hypolimnetic aeration than in the non-aerated enclosure. During the summer (June-September), SRP-P moved from the sediments to the water column of both enclosures. This suggested that iron (III) substrate might be lacking, so iron was added to the hypolimnetic water of both enclosures. In the aerated enclosure, phosphorus sedimentation occurred almost at once. In the non-aerated enclosure, iron addition had no effect. Sediment trap analysis showed that during the period of iron addition, the rate of TP-P sedimentation in the aerated enclosure increased threefold, and the ratio of iron to phosphorus in the sedimented material was 10:1. Throughout the experiment, the non-aerated enclosure lost an average of 0.7 mg SRP-P/sq m/d to the sediments, and the aerated enclosure lost 6.1 mg SRP-P/sq m/d. The results appeared to be entirely controlled by hypolimnetic oxygen concentrations and by concentration of SRP-P and T-Fe. This suggests that management of these parameters in combination with hypolimnetic aeration should yield predictable results in any stratified fresh water environment. (Author's abstract)
W87-02359

FACTORS INFLUENCING THE EFFECT OF BLEACHED KRAFT MILL EFFLUENTS ON DRINKING WATER QUALITY,

Pulp and Paper Research Inst. of Canada, Pointe Claire (Quebec).
For primary bibliographic entry see Field 5C.
W87-02365

SUSPENDED SEDIMENT PHOSPHORUS COMPOSITION IN TRIBUTARIES OF THE OKANAGAN LAKES, B.C.,
National Water Research Inst., Vancouver (British Columbia).
For primary bibliographic entry see Field 5B.
W87-02366

CANCER MORTALITY AND TYPE OF WATER SOURCE: FINDINGS FROM A STUDY IN THE UK,
London School of Hygiene and Tropical Medicine (England).
For primary bibliographic entry see Field 5C.
W87-02373

STORM WATER POLLUTION MODELLING: FIRST-ORDER ATMOSPHERIC DUSTFALL PROCESSES THAT AFFECT RUNOFF QUALITY,
McMaster Univ., Hamilton (Ontario). Dept. of Civil Engineering and Engineering Mechanics.
B. Shivalingaiah, and W. James.
Canadian Journal of Civil Engineering CJCEB8, Vol. 13, No. 1, p 95-105, February 1986. 7 fig, 4 tab, 15 ref.

Descriptors: *Storm water, *Water pollution, *Model studies, *Air pollution, *Water quality, *Path of pollutants, Storm runoff, Regression analysis, Statistical analysis, Hamilton, Ontario, Precipitation, Wind.

The buildup of surface pollutants has been shown to be a controlling factor in the quality of storm water runoff. In industrial areas particularly, atmospheric fallout is an important component of surface pollutant loadings. Storm water runoff models presently in use do not consider the physics of atmospheric dustfall. Industries, vehicle exhausts, and blowing of wind over unprotected surfaces all introduce pollutants to the atmosphere. Redistribution of this material on the ground depends on local topography and prevailing meteorological conditions. The location of the industrial areas; the direction, velocity, and duration of wind; total precipitation; and source concentrations are important parameters in the prediction of atmospheric dustfall. The paper describes the physical processes of atmospheric fallout that are relevant to water quality modelling. A new model, called ATMDST, to predict dustfall on individual subcatchments in a metropolitan area using prevailing meterological conditions is developed based on statistical methods. Results from average, one-variable and two-variable linear regression models were statistically compared with observed data. Finally, ATMDST is interfaced with the storm water management model version 3 (SWMM3) to compute runoff water quality. The model is applied to Hamilton, Ontario. (Author's abstract)
W87-02377

DENITRIFICATION RATES IN RELATION TO STREAM SEDIMENT CHARACTERISTICS,
York Univ., North York (Ontario). Dept. of Geography.
For primary bibliographic entry see Field 5B.
W87-02402

EMPIRICAL MODEL FOR DISAPPEARANCE OF FREE OXIDANTS IN NATURAL WATER WITH WIDE SALINITY AND AMMONIA RANGES,
Osaka City Inst. of Public Health and Environmental Sciences (Japan).
For primary bibliographic entry see Field 5B.
W87-02404

TOTAL AND GROUP PARAMETERS AS A MEASURE FOR THE CONTAMINATION OF WATERS WITH ORGANIC SUBSTANCES ILLUSTRATED BY EXAMPLE OF THE RIVER RHINE, (SUMMEN-UND GRUPPENPARAMETER ALS MASS FUER DIE BELASTUNG EINES GEWAESSERS MIT ORGANISCHEN STOFFEN, DARGESTELLT AM BEISPIEL DES RHEINS),
Karlsruhe Univ. (Germany, F.R.). Lehrstuhl fuer Wasserchemie.
For primary bibliographic entry see Field 5A.
W87-02435

HAZARDOUS WASTE SITE ASSESSMENT ON A 'BARE BONES' BUDGET,
Wright Water Engineers, Inc., Denver, CO.
For primary bibliographic entry see Field 5B.
W87-02439

SITE ASSESSMENTS TO DETERMINE THE PRESENCE OF HAZARDOUS MATERIALS,
Rizzo Associates, Inc., Natick, MA.
J. A. Jankauskas, A. D. Magee, E. E. Moyer, and W. J. Rizzo.
IN: The Second Annual Eastern Regional Ground Water Conference, July 16-18, 1985, Portland, Maine. 1985. p 36-50.

Descriptors: *Hazardous wastes, *Waste disposal, *Site assessments, *Water pollution sources, Regulations, Standards, Path of pollutants.

An inspection or site assessment is performed in order to determine the liklihood of the presence of oil and/or hazardous materials on a property and the extent and impact of release, if any, of these substances to the environment. The ultimate purpose of the site assessment is to determine the liklihood of the clean-up and lien provisions of the Massachusetts Oil and Hazardous Materials Release Prevention and Response Act (Chapter 21E) being exercised on a property. This assessment should include research of adjacent properties to determine if any off-site discharges may have migrated to the site. At the onset, it must be recognized that the site assessment process is not governed by any organized body of science or law. No regulations pursuant to Chapter 21E have been issued, and there are no official standards for evaluating a site. In addition, in those instances where a contaminated site is found through the 21E process, the state has not established a firm policy on how to follow up. As a result, the engineering firms and title insurance companies have established their own informal guidelines to conduct the studies. The purpose of this paper is to discuss those guidelines as they have evolved through the two years of experience with the Act. A commercial or industrial property transaction is the vehicle which trigger the site assessment certification for a title insurance company. Although the site assessment process has not been perfected, the procedure does detect a significant number of local 'hot spots' of contamination. In addition, the super lien provision provides an economical incentive for proper containment and disposal of soil and hazardous substances in the future. (See also W87-02437) (Lantz-PTT)
W87-02440

APPLICATION OF QUALITATIVE RISK ASSESSMENT TO ASSIST IN EVALUATING REMEDIAL ACTION ALTERNATIVES,
Camp, Dresser and McKee, Inc., Boston, MA.
L. J. Partridge.
IN: The Second Annual Eastern Regional Ground Water Conference, July 16-18, 1985, Portland, Maine. 1985. p 51-63, 4 fig, 2 ref.

Descriptors: *Risk assessment, *Water pollution treatment, *Groundwater pollution, Water pollution control, Cost analysis, Groundwater quality, Containment systems, Cutoffs, Cancer, Water pollution effects, Model studies.

The application of a quantitative risk assessment is employed to evaluate the cost effectiveness of remedial action alternatives at an abandoned hazardous waste disposal site. A four-stage cancer model was employed to evaluate the risk to the exposed population of ingesting groundwater contaminated with four carcinogenic chemicals (benzene, trichloroethylene, chloroform, and 1,2-dichloroethane). Three remedial actions were evaluated (no action, groundwater treatment, and groundwater containment and treatment) to assess the level of risk reduction following implementation. Baseline risk was evaluated as the equivalent of 14 excess cancers over the 30 year exposure period studied during the analysis. Under the implementation of the remedial alternatives, the baseline risk was reduced by 58% for the implementation of a groundwater treatment system, and 72% for a containment wall in combination with a groundwater treatment system. The net present value costs for each system were calculated and the marginal costs for implementation compared with the incremental reduction in cancer risk. The results suggest that the marginal costs for implementing the more costly alternative should be carefully examined in terms of expenditures per number of incidents avoided. (See also W87-02437) (Lantz-PTT)
W87-02441

UNDERGROUND TANKS THREATEN GROUND WATER QUALITY,
Massachusetts Audubon Society, Lincoln.
For primary bibliographic entry see Field 5B.
W87-02446

NEW REQUIREMENTS FOR UNDERGROUND STORAGE TANKS,
Environmental Protection Agency, Washington, DC.
G. F. Kotas, K. G. Garrahan, and A. O. Buonocore.
IN: The Second Annual Eastern Regional Ground Water Conference, July 16-18, 1985, Portland, Maine. 1985. p 145-156, 2 tab, 8 ref.

Descriptors: *Legislation, *Storage tanks, *Underground storage, Regulations, Groundwater pollution, Water pollution sources, Path of pollutants, Water quality control.

The Hazardous and Solid Waste Amendments of 1984 became Law on November 8, 1984 and, in addition to reauthorizing and making numerous changes to the Resource Conservation and Recovery Act (RCRA), a New Subtitle I was added that requires the EPA to establish a comprehensive program for the regulation of underground storage tanks. Subtitle I addresses underground storage in tanks of all substances regulated under 'Superfund' (except for hazardous waste storage tanks which are already regulated under Subtitle C of RCRA), as well as petroleum products. It is estimated that over two million underground tanks are subject to regulation under the new program. Congress enacted the legislation for regulating underground storage tanks due to the increasing number and severity of environmental contamination incidents that have been discovered as a result of leaking underground tanks. There is growing evidence that leaking tanks are becoming a major cause of groundwater contamination. The major provisions of Subtitle I include notification by owners of underground tanks to designated State or local agencies, an interim prohibition on installing unprotected new tanks, the development of technical standards for new and existing underground tanks, and tough new enforcement authorities to compel compliance with the new regulatory requirements. Subtitle I also allows EPA to promulgate financial responsibility regulations for taking correction action (cleanup) and compensating third parties for bodily injury and property damage caused by leaks from tanks. In addition, EPA is required to authorize State programs regulating underground storage tanks in lieu of the Federal program provided that the State's program is as comprehensive, stringent, and provides for adequate enforcement. (See also W87-02437) (Author's abstract)
W87-02447

UNDERGROUND TANK PRIORITIZATION - WHERE DO WE START. PLANNING AND IMPLEMENTING AN UNDERGROUND TANK MANAGEMENT PROGRAM FOR A MULTI-SITE/ MULTI-TANK FACILITY,
RMT, Inc., Madison, WI.

R. J. Robbins, and R. M. Lemunyon.
IN: The Second Annual Eastern Regional Ground Water Conference, July 16-18, 1985, Portland, Maine. 1985. p 157-164, 4 fig.

Descriptors: *Underground storage, *Management planning, *Underground waste disposal, *Waste management, *Groundwater pollution, *Water pollution control, Waste disposal, Hazardous wastes, Leaking, Soil contamination, Decision making, Assessments.

Within the next four years over one million tanks will leak toxic and hazardous material, contaminating soil and groundwater resources. The American Petroleum Institute estimates that 40%-75% of the 3.5 million underground storage tanks buried across the country are leaking now or will be shortly. A system was devised which allows for consistency of assessment, reproducibility, and reduced potential for personal biases, in assigning priorities for underground tank storage decision making. This ranking gives no assurance that the lower ranked tanks or tank farms will not cause serious problems. It simply represents a rational approach for establishing priorities and taking action. The system allows for consideration of 15-20 individual site-specific characteristics, all having an effect on the relative potential liability exposure, and promotes further study of the tanks and tank farms, which present the greatest potential to develop leaks based on an evaluation of specific environmental, chemical, mechanical, and regional factors with respect to a comprehensive program of underground tank management. From this ranking appropriate recommendations for remedial action can be proposed such as: (1) Inventory reconciliation; (2) Hydrostatic tank testing; (3) Redesign and replacement of storage tanks; (4) Abandonment of underground tanks; (5) Installation of groundwater monitoring wells; and (6) Installation of electrical leak detection system. This ranking is designed to aid plant engineers, environmental affairs directors, and plant production engineers to plan preventive maintenance programs for underground storage tank facilities. These recommendations follow sound investigative study and are based on a logical approach to a complex scenario. (See also W87-02437) (Lantz-PTT)
W87-02448

AVAILABLE TECHNOLOGY FOR THE MONITORING OF UNDERGROUND STORAGE TANKS,
Veterans Administration Hospital, Denver, CO.
R. A. Scheinfeld.
IN: The Second Annual Eastern Regional Ground Water Conference, July 16-18, 1985, Portland, Maine. 1985. p 165-181, 9 fig, 2 ref.

Descriptors: *Monitoring, *Underground waste disposal, *Storage tanks, *Water pollution control, *Measuring instruments, *Groundwater pollution, Thermal conductivity, Resistivity, Solubility, Grab samplers, Refractivity, Permeability.

Some industry experts estimate that of 1.4 million underground storage tanks containing gasoline, 100,000 may be leaking into the nation's groundwater, the present or potential source of drinking water in many areas. With growing public pressure on government to take action on this subject, one third of the states and over one hundred counties and municipalities have instituted regulatory measures of one sort or another on their books. Many of these regulations specify that some sort of leak detection device be used as the first line of defense against extensive soil and groundwater contamination due to leaks. As little as two years ago, there were less than five manufacturers producing leak devices. Today, there are fifty different devices, which fall into six groups including: thermal conductivity sensors, resistivity sensors, product soluble devices, grab sampling, refractive index sensors and product permeable sensors. It is therefore important, when evaluating detection devices, to consider efficiency, durability and cost, as well as the regulatory requirements of your region. A well thought-out choice in a leak detector will save money by alerting the owner/operator to product loss due to leaks. But most importantly, the correct detector will help limit the substantial financial liability that could be imposed as the result of environmental damage from a leaking tank. (See also W87-02437) (Lantz-PTT)
W87-02449

SUBSURFACE MONITORING TECHNIQUES FOR THE DETECTION OF LEAKS NEAR GASOLINE UNDERGROUND STORAGE TANKS,
New Hampshire Water Supply and Pollution Control Commission, Concord.
For primary bibliographic entry see Field 5B.
W87-02450

REPLACEMENT OF SALT CONTAMINATED WATER SUPPLIES IN BEDROCK AQUIFERS IN MAINE,
Maine Dept. of Transportation, Augusta.
For primary bibliographic entry see Field 5C.
W87-02451

APPLICATION OF SURFACE GEOPHYSICS TO GROUND WATER MANAGEMENT PLANNING,
Weston (Roy F.), Inc., West Chester, PA.
T. A. Drew, A. Thomas, and R. Wyatt.
IN: The Second Annual Eastern Regional Ground Water Conference, July 16-18, 1985, Portland, Maine. 1985. p 232-242, 4 fig.

Descriptors: *Geophysics, *Geohydrology, *Groundwater management, *Groundwater pollution, Delaware, Electromagnetic waves, Conductivity, Path of pollutants, Landfills, Water quality control.

The role of geophysical techniques in the development of a groundwater management plan was discussed for several inactive landfills in Sussex County, Delaware. Electromagnetic (EM) surveys were conducted downgradient of each landfill to map variations of terrain conductivity related to leachate migration in the groundwater system. Delineation of the plume of groundwater contamination from the EM data provided contaminant migration patterns and the extent of groundwater contamination around the landfill. Present-day risks to public water supplies were assessed, and temporary remedial actions were implemented for one supply well. Projected migration of the leachate-contaminated groundwater could potentially affect the water quality of several domestic wells at the Bridgeville and Laurel Landfills. Boundaries of the contaminant plume identified with analyses of the EM results assisted in the positioning of additional monitor wells to provide needed analytical data. The EM surveys and analytical data collection program will be integrated to formulate an effective groundwater management plan for each landfill. The goal of the management plan is to protect ground and surface water supplies, and to generate groundwater use restriction zones in the vicinity of the landfills. (See also W87-02437) (Lantz-PTT)
W87-02453

HAZARDOUS WASTE INVESTIGATIONS IN FRACTURED BEDROCK: A CASE STUDY,
NUS Corp., Bedford, MA.
B. K. Buckley, R. J. DeLuca, and P. J. McGlew.
IN: The Second Annual Eastern Regional Ground Water Conference, July 16-18, 1985, Portland, Maine. 1985. p 416-425.

Descriptors: *Hazardous wastes, *Bedrock, *Aquifers, *Groundwater pollution, *Water pollution control, Case studies, Geologic fractures, Water analysis, Water sampling, Geophysics, Pump tests, Drilling, Test wells, Monitoring, New Hampshire.

A remedial investigation was conducted at a hazardous waste site in New Hampshire, utilizing such methods as: (1) collection and analysis of groundwater samples to define contaminant extent; (2) downhole geophysical logging of open bedrock boreholes to delineate bedrock fractures; (3) drilling and installation of additional monitoring wells; and (4) performance of a pump test of the supply well combined with a bedrock tracer study. The principal problem at the site was volatile organic contamination of a fractured bedrock aquifer which supplies water to numerous local residents. The results suggested the following: (1) That the bedrock fracture system is extensive, that the principal direction of fracture alignment (and groundwater flow) is strongly correlated to regional geologic structure, and that the primary water-bearing fractures are located at relatively shallow depths; (2) That contaminant travel times in overburden appear to correlate with historical information on waste disposal activities; (3) That contaminants found in groundwater from bedrock and overburden correlate well with contaminants found in the soil/ overburden in source areas; (4) That pumping of the primary supply well could have drawn in contaminated groundwater from several of the source areas; and (5) That the contaminants in the bedrock aquifer appear to be amenable to removal by treatment, suggesting that a pump-and -treat remedial scenario may be a viable option for restoring this bedrock aquifer. (See also W87-02437) (Lantz-PTT)
W87-02464

RESPONSE TO GASOLINE CONTAMINATION OF RESIDENTIAL WATER WELLS - A CASE STUDY,
T. W. Heenan, G. W. Lee Jr., and E. R. Lynch.
IN: The Second Annual Eastern Regional Ground Water Conference, July 16-18, 1985, Portland, Maine. 1985. p 490-505, 3 fig, 5 tab.

Descriptors: *Gasoline, *Domestic water, *Wells, Case studies, *Groundwater pollution, Volatile organics, Benzene, Activated carbon, Iron, Water treatment, Drinking water, Water quality control.

Point-of-use water treatment using granular activated carbon provides a practical method for the removal of volatile organic compounds, such as benzene, from residential well water supplies. Advances in granular activated carbon technology allow carbon bed sizes to be in the 2- to 4-cu ft range. In areas where groundwater contains high levels of naturally occurring contaminants such as Fe(2+), H2S, pretreatment may be necessary to ensure efficiency of the carbon adsorption units and to provide acceptable drinking water quality. Available guidelines, coupled with proper water quality analysis and sound engineering practices, allow the design of safe, reliable carbon adsorption systems. Equipment is readily available for systems which can be tailored to individual residences at a reasonable cost. (See also W87-02437) (Lantz-PTT)
W87-02470

EVALUATION OF CONTAMINATION BY ORGANICS AND HEAVY METALS IN A SOIL AND BEDROCK AQUIFER,
Goldberg-Zoino and Associates, Inc., Newton Upper Falls, MA.
F. W. Clark, and P. M. Sanborn.
IN: The Second Annual Eastern Regional Ground Water Conference, July 16-18, 1985, Portland, Maine. 1985. p 529-542, 7 fig, 1 tab.

Descriptors: *Organic compounds, *Heavy metals, *Soil contamination, *Aquifers, *Water pollution treatment, *Groundwater pollution, Bedrock, New England, Path of pollutants, Volatile organics, Piezometers, Water sampling, Monitoring, Geohydrology, Trichloroethylene, Tetrachloroethylene, Dichloroethylene, Cost analysis.

A site evaluation focusing on manufacturing areas and the use of heavy metals and acid solutions, was performed at an industrial facility in New England. When groundwater screening data indicated the presence of volatile organic compounds, the scope of the study was expanded to assess contaminant distribution and impact on downgradient receptors. A multi-phase exploration and testing program included placement of single and multi-level well installations in the overburden aquifer, and gas driven samplers and pneumatic piezometers in cored bedrock zones. Movement and the eventual fate of contaminants was evaluated by sampling the extensive well network and receiving water

abutting the site, a groundwater tracer study, and a tracer/dispersion analysis in the receptor stream. Results of the hydrogeologic study indicated that elevated concentrations of priority pollutant metals were confined to a limited area on-site. However, chlorinated organic compounds (primarily trichloroethylene, tetrachloroethylene and trans-1,2-dichloroethylene) were observed in soil and bedrock. Since evidence indicated limited migration of metals, remedial studies focused on abating migration of organic compounds. Local hydrogeologic conditions precluded consideration of containment at the site, but facilitated groundwater extraction and treatment as the most cost efficient approach. Remedial studies included additional drilling and testing soil and bedrock zones, a dual-aquifer pump test, and a pilot groundwater treatment system using counter-current aeration techniques. Treated groundwater was returned to the aquifer via a recharge trench located upgradient of contaminated zones. Groundwater quality and treatability data from the pump test were used to design a full scale extraction/treatment system now operational at the site. (See also W87-02437) (Author's abstract)
W87-02473

IS CURRENT TECHNOLOGY THE ANSWER.
National Water Supply Improvement Association, Springfield, VA.
Available from the National Water Supply Improvement Association, P.O. Box 1344, Springfield, VA. 22151. (1986). Proceedings of the First Biennial Conference, June 8-12, 1986, Washington, DC. 426 p.

Descriptors: *Water quality control, *Water treatment, *Wastewater treatment, Reverse osmosis, Electrodialysis, Salinity, Case studies, Research priorities, Conferences, Water supply development.

This conference covered several topics beginning with an overview of the problems involved with today's water supply systems, such as salinity control, organic contaminants, and drinking water quality. The discussions then turn to: current technology (electrodialysis, reverse osmosis, vapor compression, etc.), case studies involving the application of water treatment processes, what direction current and future research should take, and water supply programs currently in place in the United States. (Aee also W87-02477 thru W87-02496) (Lantz-PTT)
W87-02476

COLORADO RIVER WATER QUALITY IMPROVEMENT PROGRAM,
Bureau of Reclamation, Denver, CO. Colorado River Water Quality Office.
For primary bibliographic entry see Field 5F.
W87-02477

REMOVAL OF ORGANIC CONTAMINANTS FROM GROUNDWATER: STATUS OF EPA DRINKING WATER RESEARCH PROGRAM,
Environmental Protection Agency, Washington, DC. Office of Research and Development.
For primary bibliographic entry see Field 5F.
W87-02478

POTENTIAL FOR DESALTING IN HAMPTON ROADS, VIRGINIA,
For primary bibliographic entry see Field 3A.
W87-02479

KESTERSON STORY,
Bureau of Reclamation, Sacramento, CA. Mid-Pacific Regional Office.
For primary bibliographic entry see Field 5C.
W87-02480

REVIEW OF ELECTRODIALYSIS,
Ionics, Inc., Watertown, MA.
For primary bibliographic entry see Field 3A.
W87-02481

ENERGY RECOVERY IN LOW PRESSURE MEMBRANE PLANTS,
Post, Buckley, Schuh and Jernigan, Inc., Fort Myers, FL.
For primary bibliographic entry see Field 3A.
W87-02484

PROCEEDINGS OF THE FIFTH NATIONAL SYMPOSIUM AND EXPOSITION ON AQUIFER RESTORATION AND GROUND WATER MONITORING.
National Water Well Association, Worthington, OH.
For primary bibliographic entry see Field 2F.
W87-02497

ASSISTANCE FOR RCRA PERMIT APPLICANTS,
Environmental Protection Agency, Chicago, IL. Region V.
R. Traub.
IN: Proceedings of the Fifth National Symposium and Exposition on Aquifer Restoration and Ground Water Monitoring, May 21-24, 1985, The Fawcett Center, Columbus, Ohio. 1985. p 15-24, 2 tab, 6 ref.

Descriptors: *Permits, *Groundwater protection, *Resource Conservation and Recovery Act, Legal aspects, Groundwater quality, Water quality control, Path of pollutants, Monitoring, Wells, Aquifers, Groundwater pollution.

Preparation of a Resource Conservation and Recovery Act (RCRA) Part B permit application is a time consuming, resource intensive, and sometimes frustrating experience. In addition, facilities will face new requirements as a result of the passage of the Hazardous and Solid Waste Amendments of 1984. Delays in the processing and issuance of RCRA permits are most often caused by incomplete applications, largely due to a lack of understanding by the applicant of what is required. For units subject to groundwater monitoring, the principal deficiency is the lack of adequate data to satisfy the additional information requirements of 40 CFR 270.14 (c), regarding groundwater protection. Facilities consistently fail to provide adequate information relating to aquifer characteristics, groundwater contamination, and the proposed monitoring program. To assist in the preparation of Part B permit applications, the United States Environmental Protection Agency (U.S. EPA), has published guidance documents which describe the level of detail necessary in a permit application. The guidelines provide insight into identification of the uppermost aquifer, determining points of compliance and well locations, describing groundwater contamination, selection of the appropriate monitoring program, and other requirements. Information regarding specific facility standards, such as contingency and waste analysis plans, is also available. Regional EPA technical staff are prepared to assist applicants in use of these documents, and in developing their Part B application. Use of appropriate guidelines, and regular communications with Federal and State permit staff, can improve the quality of the application and alleviate much of the confusion associated with the permitting process. (See also W87-02497) (Author's abstract)
W87-02498

RCRA PERMIT PROTOCOL FOR A CORRECTIVE ACTION PROGRAM,
Environmental Protection Agency, Washington, DC.
R. Steimle.
IN: Proceedings of the Fifth National Symposium and Exposition on Aquifer Restoration and Ground Water Monitoring, May 21-24, 1985, The Fawcett Center, Columbus, Ohio. 1985. p 38-42.

Descriptors: *Resource Conservation and Recovery Act, *Water quality control, *Protocol, Monitoring, Groundwater quality, Wastewater lagoons, Landfills, Leaching, Wells, Water pollution treatment, Aquifers, Permits.

Since 1981, most land disposal facilities have been required to monitor groundwater on-site under the Resource Conservation and Recovery Act (RCRA) regulations. Analyses of the accumulated water quality data indicate that many facilities are degrading groundwater because of a failure to contain the wastes. When such facilities receive a RCRA permit, in most cases, they will be required to conduct a corrective action program to renovate the groundwater quality. In addition, the 1984 amendments to RCRA require a permit applicant to perform corrective action if any solid waste management units on-site are leaking, regardless of when the waste was placed in the unit. These units include old, unregulated, closed lagoons and landfills which, in our experience, have caused the greatest damage to groundwater quality. The corrective action plan must include a groundwater monitoring program which is designed to demonstrate the effectiveness of corrective action. In most cases this will be incorporating the existing wells at the point of compliance and additional wells beyond that perimeter in and near the zone of contaminated groundwater. The permittee must report, in writing to EPA, a confirmation that the corrective action plan is functioning as designed. When the groundwater has been renovated so that the permit concentration levels at the point of compliance have not been exceeded for a period of three consecutive years, the permittee may terminate corrective action measures. In most cases, the RCRA permit should also include compliance monitoring conditions so that the end of corrective action will not require a permit modification. Presently EPA is reviewing proposed corrective action plans in RCRA permit applications. (See also W87-02497) (Lantz-PTT)
W87-02499

GROUND WATER MONITORING IN FLORIDA -- LIVING WITH HYDROLOGIC AND REGULATIVE PECULIARITIES,
Geraghty and Miller, Inc., Tampa, FL.
For primary bibliographic entry see Field 2F.
W87-02500

POINT-IN-TIME COMPARISON; AN ALTERNATIVE TO THE STATISTICAL REQUIREMENTS OF RCRA ACCEPTED BY EPA,
B. Hockman, and J. Cibrik.
IN: Proceedings of the Fifth National Symposium and Exposition on Aquifer Restoration and Ground Water Monitoring, May 21-24, 1985, The Fawcett Center, Columbus, Ohio. 1985. p 49-59, 17 ref.

Descriptors: *Statistical analysis, *Resource Conservation and Recovery Act, West Virginia, Groundwater quality, Regulations, Legislation, Monitoring, Water quality control, Wells, Water sampling, Hazardous wastes, Waste management, Statistical analysis.

Significant modification of the statistical requirements of 40CFR264 Subpart F has been included in the final West Virginia Hazardous Waste Management Regulations. Modifications, based on literature review and personal communications with both academic and regulatory statisticians and groundwater professionals, were incorporated into the State requirements. These changes addressed weaknesses acknowledged by the above sources in the Federal Regulations including seasonal and year-to-year effects due to the use of pooled background data, non-normal distribution of data, and inadequate sample size. The State requirements are based on a point-in-time comparison made each quarter on independent groundwater samples collected in that quarter from both upgradient and downgradient wells. This scheme differs significantly from the federal method that is based on the comparison of replicated aliquots of a single downgradient sample with the annual mean of replicated aliquots collected upgradient quarterly. The statistical requirements included in the West Virginia Hazardous Waste Management Regulations were evaluated by EPA Headquarters and Region III and deemed 'acceptable' for inclusion in the West Virginia Hazardous Waste Management Program for RCRA final authorization. Therefore, a statistical method that has already been through the protracted mechanisms required for EPA regula-

tory acceptance is available for inclusion in waste management permits in West Virginia and may be applicable in other states. (See also W87-02497) (Author's abstract)
W87-02501

REMEDIAL ALTERNATIVES FOR SOURCE ABATEMENT: THE NECESSARY STEP,
O.H. Materials Co., Findlay, OH.
For primary bibliographic entry see Field 5B.
W87-02504

SYSTEMATIC APPROACH FOR EVALUATING THE QUALITY OF GROUND WATER MONITORING DATA,
Kennedy/Jenks Engineers, San Francisco, CA.
For primary bibliographic entry see Field 7C.
W87-02513

USE OF CONDUCTIVITY PROFILES IN GROUND WATER QUALITY INTERPRETATION,
Jordan (Edward C.) Co., Inc., Portland, ME.
R. M. Burger, and D. C. Allen.
IN: Proceedings of the Fifth National Symposium and Exposition on Aquifer Restoration and Ground Water Monitoring, May 21-24, 1985, The Fawcett Center, Columbus, Ohio. 1985. p 283-309, 18 fig, 1 tab, 8 ref.

Descriptors: *Conductivity, *Groundwater quality, *Path of pollutants, Data interpretation, Monitoring wells, New England, Groundwater movement, Geohydrology, Distribution pattern, Chemical analysis, Pump tests.

Based on an examination of groundwater conductivity, profile data, collected from twenty-one monitoring wells at six different sites in northern New England, the following conclusions have been reached: (1) Periodic conductivity profiling may be used to monitor horizontal and vertical migration of groundwater contamination; (2) Conductivity profiles appear to indicate localized variations within the screened intervals of monitoring wells. These variations do not appear to correlate with changes in the physical characteristics of the hydrogeologic regime; (3) The shape of some conductivity profiles may indicate the screened interval does not fully penetrate the zone of contamination or that it is above or below the zone of contamination; (4) Conductivity profiles may help to identify groundwater impacts that limited chemical analysis or standard field monitoring procedures may not identify; (5) Conductivity profiles measured before wells are purged have shown significant differences from in-situ conductivity values of purged well samples collected during monitoring events. This varisbility suggests that the sample conductivity may in fact be controlled by the location of the suction tubing or pump within the well especially in high permeability formations; and (6) Conductivity profiles may be used as a preliminary screening tool in assessing the need and positioning of a monitoring well network. (See also W87-02497) (Lantz-PTT)
W87-02514

OPTIMAL HYDRAULIC CONTAINMENT OF CONTAMINATED GROUND WATER,
EMCON Associates, San Jose, CA.
D. F. Atwood, and S. M. Gorelick.
IN: Proceedings of the Fifth National Symposium and Exposition on Aquifer Restoration and Ground Water Monitoring, May 21-24, 1985, The Fawcett Center, Columbus, Ohio. 1985. p 328-344, 9 fig, 6 ref.

Descriptors: *Hydraulic design, *Groundwater pollution, *Water pollution treatment, Aquifer, Hydraulic models, Simulation analysis, Groundwater movement, Completion models, Model studies, Wells, Pumping, Groundwater recharge, Cleanup operations.

A major problem in aquifer restoration is preventing contaminated groundwater from migrating with the regional groundwater flow during the lengthy cleanup process. Typically, aquifer simulation is used on a trial and error basis to explore cleanup strategies. This approach is inefficient and does not guarantee that the best solution will be found. A method is demonstrated here that determines the best containment strategy by combining a groundwater flow simulation model with the management technique of linear programming, together referred to as a simulation-management model. The hydraulic validity of the solution is ensured by directly incorporating the groundwater flow model in the linear programming constraints as an hydraulic response matrix. In addition, a solute transport model is used, first to aid in the formulation of the simulation management model, and second to check the optimal solution. The method is demonstrated using a hypothetical contaminated groundwater problem with data from the Rocky Mountain Arsenal near Denver, Colorado. From a specified set of potential well sites, the simulation management model choses the best wells and optimal pumping/recharge rate schedules to contain the contaminant plume. For hydraulic gradient control, wells are deactivated far from the plume perimeter and are activated near the perimeter as the plume decreases in size. Subsequent solute transport simulation confirms that the optimal hydraulic design successfully isolates the contaminant plume during aquifer cleanup. The general methodology of the simulation management model can be applied to a wide range of groundwater contamination problems. (See also W87-02497) (Author's abstract)
W87-02516

GRADIENT CONTROL FOR CONTAINMENT OF POLLUTANTS,
Geotechnical Engineers, Inc., Winchester, MA.
S. J. Poulos, and A. C. Laws.
IN: Proceedings of the Fifth National Symposium and Exposition on Aquifer Restoration and Ground Water Monitoring, May 21-24, 1985, The Fawcett Center, Columbus, Ohio. 1985. p 390-399, 3 fig.

Descriptors: *Gradient control, *Water pollution control, *Groundwater pollution, Water conveyance, Slurry walls, Sand drains, Wick drains, Cost-benefit analysis, Groundwater movement.

A gradient control system is one which causes the groundwater gradient to be reduced locally to near-zero values by installing extremely pervious connections between the groundwater upstream and downstream from a contaminant source. Thus clean upstream water is caused to bypass the source and to recharge the downstream groundwater. The contaminants are trapped at the source nearly as effectively as if an impervious wall were installed around it. A variety of existing sewer installation and construction dewatering technologies can be used to install a gradient control system. New developments, such as the use of pervious 'slurry' walls, sand drains, wick drains, and other techniques, may render gradient control increasingly cost effective. Gradient control systems can be installed at any site where dumping has contaminated the soil and rock and where groundwater is flowing across the site causing migration downstream. Inclusion of a gradient control system at chemically secure or other landfills will provide a final line of defense against migration of any contaminants that might leak through the primary control systems. (See also W87-02497) (Lantz-PTT)
W87-02520

SUBSURFACE POLLUTION CONTAINMENT USING A COMPOSITE SYSTEM VERTICAL CUT-OFF BARRIER,
Wehran Engineering Corp., Middletown, NY.
For primary bibliographic entry see Field 8A.
W87-02521

EFFECTIVENESS OF A COMPACTED CLAY LINER IN PREVENTING GROUND WATER CONTAMINATION,
Science and Education Administration, University Park, PA. Northeast Watershed Research Center.
For primary bibliographic entry see Field 8G.
W87-02522

MITIGATION OF HYDROCARBON CONTAMINATION IN WATER SUPPLY AQUIFERS VIA MULTI RECOVERY WELL FOR HYDROLOGIC CONTROL,
Groundwater Technology, Inc., Concord, CA.
W. Smith.
IN: Proceedings of the Fifth National Symposium and Exposition on Aquifer Restoration and Ground Water Monitoring, May 21-24, 1985, The Fawcett Center, Columbus, Ohio. 1985. p 432-448, 8 fig.

Descriptors: *Hydrocarbons, *Aquifers, *Groundwater pollution, *Water quality control, *Water supply, Path of pollutants, Plumes, Water treatment, Polyphosphate, Scaling, Water pollution treatment.

A multiple pumping well abatement program was successful at controlling the dissolved contaminant plume migration while recovering the free floating product plume. The dissolved hydrocarbon plume has been observed to be controlled and reduced since initiation of the pumping program. The water treatment system operated as originally designed with the exception of the addition of the soluble polyphosphate reagent to reduce the scaling problems. The treatment system has consistently reduced influent concentrations to less than 100 ppb total hydrocarbons as required. Additional modifications to the system are presently being researched to expedite recovery and rehabilitation of the groundwater regime. These modifications may include stimulation of subsurface biological activity to enhance biodegradation of the hydrocarbons dissolved in the water table or adsorbed onto the subsoils. (See also W87-02497) (Lantz-PTT)
W87-02523

USE OF DIRECT-READING GROUNDWATER FLOWMETERS AND WATER LEVELS TO DETERMINE THE RECOVERY ZONE OF A PUMPING WELL,
K-V Associates, Inc., Falmouth, MA.
W. B. Kerfoot.
IN: Proceedings of the Fifth National Symposium and Exposition on Aquifer Restoration and Ground Water Monitoring, May 21-24, 1985, The Fawcett Center, Columbus, Ohio. 1985. p 462-475, 5 fig, 1 tab, 7 ref.

Descriptors: *Flowmeters, *Groundwater, *Water level, *Pump wells, *Groundwater movement, *Flow patterns, Mathematical analysis, Flow profile, Withdrawal, Hydraulic conductivity.

The addition of vector analysis to standard pump tests provides a powerful new mathematical tool for understanding altered groundwater flow and recovery well design. The capacity to vertically profile velocity changes and velocity patterns across the unperturbed substrata allows a level of redundant computations for hydraulic conductivity which was not previously attainable. The ability to easily define the vertical zone of influence (m) provides a quick check on partial penetration influences of well withdrawal. In addition, the combination of horizontal and vertical changes in observed velocity allows the field determination of anisotropy (i.e., differences in hydraulic conductivity in the x, y, and z axis), heretofore attainable only with multiple piezometric determinations. (See also W87-02497) (Lantz-PTT)
W87-02525

VACUUM: DEFENSE SYSTEM FOR GROUND WATER VOC CONTAMINATION,
Geotec, Caparra Heights, PR.
J. C. Agrelot, J. J. Malot, and M. J. Visser.
IN: Proceedings of the Fifth National Symposium and Exposition on Aquifer Restoration and Ground Water Monitoring, May 21-24, 1985, The Fawcett Center, Columbus, Ohio. 1985. p 485-494, 4 fig, 4 ref.

Descriptors: *Water pollution treatment, *Groundwater pollution, *Vacuum pumps, Volatile organics, Vadose zone, Carbon tetrachloride, Puerto Rico, Silt, Clays, Limestone, Aquifer, Cleanup operations, Monitoring wells.

Remedial action for volatile organic contamination of groundwater is generally a long-term, expensive operation. When a considerable amount of contamination remains in the vadose zone, continuous transport to the groundwater by percolation or vapor transport serves to extend the extent and time of required remedial actions. In the midst of an industrial complex, classical methods such as soil removal, forced percolation, encapsulation, or trenching are frequently impossible or prohibitively expensive. Such was the case when a major release of carbon tetrachloride from a ruptured underground storage tank was discovered at a site in Puerto Rico. Through subsoil investigation, it was determined that much of the released material was contained in the clayey silt overburden and karst limestone above the groundwater. Installation of vacuum extraction wells terminating in the clay and limestone, began immediately. A variety of vacuum pumps, some capable of operating at up to 29.9 inches of mercury vacuum were attached to the wells. To date, hundreds of gallons of carbon tetrachloride have been removed as a vapor from the clayey silt and fractured rock of the 300 foot deep vadose zone. Removal is very cost effective, with cost per pound removed being down to 0.001 of the cost to remove from the aquifer. On implementation of vacuum operation, improvement in source control was noted by a reduction in concentration at the vacuum wells, and reduction of contaminant levels in monitoring well levels near the site. By mass balance, the major portion of the discharge has been removed by vacuum. Disruption of the site was minimal. The extent of potential aquifer contamination remedial cost and remedial time have been greatly reduced. (See also W87-02497) (Author's abstract)
W87-02527

CONSIDERATIONS FOR THE CURRENT AND FUTURE PRACTICE OF BIORECLAMATION OF ORGANIC CONTAMINANTS/IMPORTANT ASPECTS OF FIELD APPLICABILITY IN GROUNDWATER RESTORATION,
Groundwater Technology, Inc., Chadds Ford, PA.
C. Matson.
IN: Proceedings of the Fifth National Symposium and Exposition on Aquifer Restoration and Ground Water Monitoring, May 21-24, 1985, The Fawcett Center, Columbus, Ohio. 1985. p 497-504, 5 ref.

Descriptors: *Bioreclamation, *Organic compounds, *Groundwater pollution, *Water pollution treatment, Flow rates, Geophysics, Computer programs, Cleanup operations, Water pollution control, Aquifers, Groundwater decontamination.

To achieve useful biostimulation a clear hydrogeologic picture must be composed. Expert well field design and drilling, combined with careful materials analysis yield data which when professionally examined and assembled allows for accurate graphics. These studies are enhanced by innovative geophysical methods to define zones of contamination, flow rates, and leak and spill tracing. Computerized data assimilation and presentation further clarifies the pollution picture and allows for protective measures to be installed. Bioreclamation sites should define priority location in well field design and drilling and infiltration gallery placement to economize funds. Many circumstances in spill and leak situations, are surrounded by political and physical limitations which complicate rapid recovery of free product and may in some cases exacerbate the problem by increasing the dissolved and adsorbed phase contamination. The necessity to act without delay should engender a need to establish broader public education and encourage private and public cooperation in ecological restoration efforts. The sciences of pollution abatement and bioreclamation would benefit greatly by such cooperation. These considerations are important when deciding on field applications, and planning for reduced operational difficulties. Biostimulation, feasibility, and nutrient addition studies should accompany all bioreclamation efforts to insure environmental compatability, and assure pollution reduction. The future will include combinations of technologies, for controlling off-site migration, recycling of nutrients, activation tanks, and other innovative methods, and advances in mixed biochemical adjustments and controls. These groundwater technologies give reason to hope for complete restoration of delicate aquifers at a cost of pennies per gallon with ubiquitous potential for application. (See also W87-02497) (Lantz-PTT)
W87-02528

REMEDIATION STRATEGIES USING ENHANCED BIORECLAMATION,
FMC Corp., Princeton, NJ. Aquifer Remediation Systems.
G. R. Brubaker, and E. O'Neill.
IN: Proceedings of the Fifth National Symposium and Exposition on Aquifer Restoration and Ground Water Monitoring, May 21-24, 1985, The Fawcett Center, Columbus, Ohio. 1985. p 505-509, 1 tab.

Descriptors: *Bioreclamation, *Groundwater pollution, *Water pollution treatment, *Biodegradation, Soil bacteria, Organic compounds, Pumps, Air Stripping, Solubility, Volatility, Adsorption, Carbon.

One of the emerging remediation techniques for groundwater contamination, takes advantage of the versatility of natural soil bacteria to degrade many organic molecules, leaving behind only carbon dioxide and water. The process involves the introduction of microbial nutrients (sources of oxygen, nitrogen, phosphorus and trace minerals) into the contaminated area to convert the zone of contamination into a bioactive zone of biodegradation. Like other techniques that are used for groundwater remediation, Enhanced Bioreclamation is not the complete answer for every combination of hydrogeologic conditions or chemical contaminants, but it promises to become a powerful technique in remediating certain types of sites. This paper examines the advantages and limitations of this technique, and compares them with three pump and treat techniques; air stripping, carbon treatment and surface biological treatment. This study concludes that all of the 'pump and treat' techniques are limited to situations where a delicate balance between solubility, volatility and biodegradability exists, and to a great extent that is true. But, this becomes an obstacle only when one requires the technique to both extract a contaminant from the soil into water, and then to remove it from the water. Carbon adsorption, air stripping and surface biological treatment are effective in removing low levels of some organic contamination for the purpose for which they were originally designed. The timely cleanup of contaminated soils, however, requires more aggressive remediation techniques. Enhanced Bioreclamation promises to fill that need for many biodegradable materials. Additional in-situ techniques and new creative remediation strategies must be developed for other situations. (See also W87-02497) (Lantz-PTT)
W87-02529

RESTORATION OF WATER QUALITY IN A MULTIAQUIFER SYSTEM VIA INSITU BIODEGRADATION OF THE ORGANIC CONTAMINANTS,
Groundwater Technology, Inc., Chadds Ford, PA.
P. M. Yaniga, C. Matson, and D. J. Demko.
IN: Proceedings of the Fifth National Symposium and Exposition on Aquifer Restoration and Ground Water Monitoring, May 21-24, 1985, The Fawcett Center, Columbus, Ohio. 1985. p 510-526, 9 fig, 5 ref.

Descriptors: *Water quality management, *Groundwater pollution, *Aquifer systems, *Biodegradation, *Organic compounds, Geohydrology, Water quality control, Bacteria, Pumping, Gasoline, Hydrocarbons.

Initial results of the insitu hydrogeologic control and accelerated natural bioreclamation of an aquifer contaminated with gasoline, prove quite positive. The points listed here summarize the achievements through the first months of operation: (1) Identification of naturally-occurring hydrocarbon utilizing bacteria; (2) Development of an applicable nutrient mix that stimulates hydrocarbon utilizing microbial growth in laboratory conditions; (3) Development of a hydrodynamically controlled groundwater pumping, air stripping, oxygen dissemination and water recirculation system (i.e., an in situ bioreactor); (4) Development of a field application procedure for the introduction of nutrient and oxygen to stimulate an increase in the numbers of hydrocarbon reducing organisms; and (5) Development of a comprehensive program of the above combined elements that increased the number of gasoline reducing bacteria from: 1,000 to 10,000 organisms/ml to 100,000 to 1,000,000 organisms/ml. The overall results of the combined program are the reducing of gasoline type hydrocarbon contaminants in the aquifer system. (See also W87-02497) (Lantz-PTT)
W87-02530

REMEDIATION OF A LEAKING UNDERGROUND STORAGE TANK WITH ENHANCED BIORECLAMATION,
Groundwater Technology, Inc., Chicago, IL.
M. Brenoel, and R. A. Brown.
IN: Proceedings of the Fifth National Symposium and Exposition on Aquifer Restoration and Ground Water Monitoring, May 21-24, 1985, The Fawcett Center, Columbus, Ohio. 1985. p 527-536, 2 fig, 7 tab.

Descriptors: *Hydrocarbons, *Groundwater pollution, *Cleanup operations, *Water pollution treatment, Recovery systems, Bioreclamation, Adsorption, Carbon, Cost analysis.

A remediation program was successful in eliminating the soil contamination in a fuel storage vault and in significantly reducing the groundwater contamination. Once the fugitive leak had been finally located and repaired, hydrocarbon contamination in the vault was brought under control. The project illustrates how an integrated approach to site remediation can solve severe contamination problems. Each stage of remediation was chosen for maximum efficiency in dealing with the contamination problem. A well designed free product recovery system eliminated the severe, free floating layer, reducing the abatement load for subsequent stages. Enhanced Bioreclamation was effective in removing residual dissolved hydrocarbons and controlling fugitive leaks until the plumbing system was finally repaired. The use of this integrated approach served to speed the recovery and reduce cost. For example, pumping free product is the easiest and most cost-effective method of remediating that phase. Enhanced Bioreclamation, because it treats both the adsorbed and dissolved fractions, is the most rapid method of controlling the gross contamination problem. Finally, when the dissolved level was low enough, carbon adsorption was the simplest method of polishing the groundwater. (See also W87-02497) (Lantz-PTT)
W87-02531

UNSATURATED ZONE MONITORING AND RECOVERY OF UNDERGROUND CONTAMINATION,
Terra Vac, Inc., Dorado, PR.
J. J. Malot.
IN: Proceedings of the Fifth National Symposium and Exposition on Aquifer Restoration and Ground Water Monitoring, May 21-24, 1985, The Fawcett Center, Columbus, Ohio. 1985. p 539-545, 2 fig.

Descriptors: *Monitoring, *Groundwater pollution, *Aeration zone, Vacuums, Volatile organics, Organic compounds, Underground storage, Storage tanks, Aquifers, Landfills, Carbon tetrachloride, Methylene chloride, Hexane, Acetone, Methanol, Gasoline.

A new method for monitoring underground contamination has been developed that can also be used to recover contaminants before they reach the water table. This innovative method uses vacuum technology applied to subsurface media beneath storage facilities, spill sites or pipelines. The system is most effective in detecting and recovering chemicals such as volatile organic compounds, solvents, and petroleum products, and can be installed in virtually any hydrogeological setting regardless

of the depth to the groundwater. Monitoring of underground storage tanks, landfills, lagoons and pipelines with this system can detect potential contaminants before they reach the aquifer and develop into costly groundwater problems. The same system used to monitor the unsaturated zone, with proper design, can also be used to recover contaminants without further installation of subsurface equipment. Successful application of this technology has recovered more than 300 pounds per day of carbon tetrachloride that leaked from unsuspected corrosion holes in the bottom of an underground tank. The method has been used to monitor and recover, among other pollutants, methylene chloride, hexane, acetone, methanol and gasoline. Monitoring and recovery systems have been installed in clayey soils, sand and limestone rock formations. Detecting leaks from underground storage tanks, spills from transfer operations and leachate from landfills with this method is especially effective when groundwater is relatively deep. (See also W87-02497) (Author's abstract)
W87-02532

IN SITU PHYSICAL/BIOLOGICAL TREATMENT OF METHYLENE CHLORIDE (DICHLOROMETHANE) CONTAMINATED GROUND WATER,
O.H. Materials Co., Findlay, OH.
P. E. Flathman, M. J. McCloskey, J. J. Vondrick, and D. W. Pimlett.
IN: Proceedings of the Fifth National Symposium and Exposition on Aquifer Restoration and Ground Water Monitoring, May 21-24, 1985, The Fawcett Center, Columbus, Ohio. 1985. p 571-597, 13 fig, 33 ref.

Descriptors: *Biological treatment, *Methylene chloride, *Groundwater pollution, In situ treatment, Air stripping, Monitoring wells, Cost analysis.

Many current and emerging technologies are available for the on site removal of groundwater contaminants. For cost-effective cleanup following spills of hazardous organic materials, combinations of treatment alternatives are often employed. The case history presented describes physical and biological treatment of methylene chloride contaminated groundwater following rupture of an underground pipeline. Within two months of field operation, air stripping techniques provided an estimated 97% reduction in the concentration of methylene chloride in the groundwater environment. In a downgradient monitoring well located within 20 feet of the pipeline break, methylene chloride concentration was reduced from 9,300 ppm to 300 ppm by the end of the second month. Since it became increasingly difficult to remove the remaining methylene chloride from the groundwater environment, biological techniques were initiated. Biological treatment, using adapted microbial strains, was implemented by the end of the third month and achieved an estimated 97% reduction of the residual methylene chloride in the groundwater. Within four months of field operation, greater than 99.9% of the initial methylene chloride present was removed. Cost-effectiveness, minimal disturbance to existing operations, onsite destruction of methylene chloride, and permanence of solution are among the advantages identified in this project for implementing physical/biological techniques for spill cleanup and environmental restoration. (See also W87-02497) (Author's abstract)
W87-02534

RESPONSE TO AN ENVIRONMENTAL INCIDENT AFFECTING GROUND WATER,
O.H. Materials Co., Findlay, OH.
J. R. Quince, R. J. Ohneck, and J. J. Vondrick.
IN: Proceedings of the Fifth National Symposium and Exposition on Aquifer Restoration and Ground Water Monitoring, May 21-24, 1985, The Fawcett Center, Columbus, Ohio. 1985. p 598-608, 2 fig.

Descriptors: *Groundwater pollution, *Cleanup operations, *Water pollution treatment, Monitoring wells, Biodegradation, Water sampling, Bacteria, Solvents, Dichloromethane, Soil contamination.

A specialty manufacturer experienced an underground solvent loss. The company had identified a loss of pressure in a plant water main (low pressure alarm) and, after visual surveillance of the site, the water line leak was isolated in an area of saturated soil. Excavation was undertaken to expose the water main and repair the leak. During excavation, dichloromethane (a commonly used solvent in the manufacturing process) was identified around the polyvinyl chloride (PVC) water main. Plant personnel subsequently identified the existence of two buried dichloromethane supply lines in the immediate vicinity. Upon visual surveillance, an area of 'soft' asphalt was discovered in an adjacent parking area. The dichloromethane lines were immediately removed from service and isolated. Excavation was undertaken to expose the buried dichloromethane lines. Cleanup activities were divided into three phase. Phase I was the investigative program, which entailed excavations with exploratory pits, borings and observation well installations, sampling, decontamination, identification of groundwater contamination, waste disposition, and remedial actions. Phase II was the actual remedial action program. This involved the installation of an underground recovery system, a recharge pipe system, and monitoring wells. Biological treatment was Phase III of the program, and used active bacteria for the degradation of the solvent. (See also W87-02497) (Lantz-PTT)
W87-02535

AQUIFER RESTORATION: CASE HISTORIES,
O.H. Materials Co., Findlay, OH.
D. Winegardner, M. Erickson, and J. Quince.
IN: Proceedings of the Fifth National Symposium and Exposition on Aquifer Restoration and Ground Water Monitoring, May 21-24, 1985, The Fawcett Center, Columbus, Ohio. 1985. p 611-626, 8 ref.

Descriptors: *Aquifer restoration, *Groundwater pollution, *Case studies, *Water pollution treatment, Cleanup operations, Oil spills, Gasoline, Toluene, Chlorinated hydrocarbons, Aquifers.

Restoration of aquifers following spill events can take a wide variety of forms. The degree of restoration required varies from site to site. At some locations, the primary purpose of the cleanup is to remove and/or treat all the contaminants as rapidly as possible. Elsewhere, it may be only necessary to reduce the contamination to a level that natural processes (such as enhanced biological activity or soil attenuation) will complete the cleanup. The following case histories are presented as examples of techniques used to restore individual sites under specific circumstances: Case history no. 1 resulted from corrosion of a buried diesel oil pipeline at an industrial plant; Case history no. 2 describes the recovery of floating gasoline from a local service station; Case history no. 3 resulted from a spill of degassing agent at a metal machinery factory adjacent to a small cree; Case history no. 4 considers an industrial plant in the midwest which experienced a leak which released several barrels of toluene into a shallow aquifer; and Case history no. 5, which resulted from the discovery of a chlorinated solvent in the soil near the water table at a depth of 5 to 10 feet below the surface. Each system was designed to meet locally-required cleanup criteria. All of these examples were successful and are presented here to offer guidance to other investigators facing similar circumstances. (See also W87-02497) (Lantz-PTT)
W87-02536

GROUND WATER MANAGEMENT PLAN FOR PROTECTION OF A SHALLOW AQUIFER AT THE NAVAL WEAPONS CENTER, CHINA LAKE, CALIFORNIA,
Montgomery (James M.), Inc., Pasadena, CA.
M. C. Kavanaugh, K. Fox, G. Treweek, and K. Wiebe.
IN: Proceedings of the Fifth National Symposium and Exposition on Aquifer Restoration and Ground Water Monitoring, May 21-24, 1985, The Fawcett Center, Columbus, Ohio. 1985. p 627-655, 7 fig, 5 tab, 14 ref.

Descriptors: *Groundwater management, *Aquifers, *Water pollution prevention, *China Lake, California, Groundwater movement, Flow profile, Feasibility studies, Cost-benefit analysis, Model studies, Trichloroethylene, Hydraulic gradient, Path of pollutants.

Past management practices at the Naval Weapons Center in China Lake California, have caused contamination of the soil and portions of the shallow aquifer underlying Armitage Field at the Naval Weapons Center. The existence of this contamination raises the possibility of contamination of nearby active wells currently used for non-potable purposes. In addition, future projection of groundwater flow in the Indian Wells Valley aquifer, suggest that flow reversal may occur due to groundwater pumping in the southwestern direction away from the Armitage Field site. A feasibility study of alternatives for control and mitigation of soil and groundwater contamination to protect public health and the environment was conducted. Each alternative was evaluated with respect to technical feasibility, meeting the State and federal environmental requirements and cost-effectiveness. A no-action alternative was evaluated using a three dimensional analytical model of saturated flow. The modeling results of the no-action alternative indicated that solvents such as trichloroethylene (TCE) would dissipate within a distance of .25 miles of the site thereby posing no apparent danger to the wells near Armitage Field. The model results suggested that additional monitoring was needed to determine the presence of additional contaminants that could pose problems to nearby wells because of higher mobility compared to TCE. Reversal of the hydraulic gradient in the aquifer also did not appear to pose a threat to potable wells from contaminants found under Armitage Field. (See also W87-02497) (Author's abstract)
W87-02537

PROTECTION OF A 700-GPM MUNICIPAL WELL FIELD WITH A 10-GPM BARRIER WELL,
Camp, Dresser and McKee, Inc., Boston, MA.
For primary bibliographic entry see Field 5B.
W87-02538

PETROLEUM RECOVERY IN A TIDAL ENVIRONMENT,
Chevron USA, Inc., Concord, CA.
E. L. Haven, and D. E. Jones.
IN: Proceedings of the Fifth National Symposium and Exposition on Aquifer Restoration and Ground Water Monitoring, May 21-24, 1985, The Fawcett Center, Columbus, Ohio. 1985. p 668-690, 9 fig, 2 tab, 1 ref.

Descriptors: *Oil recovery, *Tidal effects, *Water pollution treatment, *Cleanup operations, *Groundwater pollution, Bangor, Maine, Penobscot River, Monitoring wells, Alluvial aquifers.

A petroleum recovery system was designed and installed at a petroleum bulk storage terminal in Bangor, Maine in response to seepage into the adjacent Penobscot River. The recovery system had to be specially designed to take into account an average tidal fluctuation of 16 feet in the river with a corresponding 8-foot change in the groundwater beneath the site. A hydrogeological investigation included the installation of groundwater monitoring wells to determine the hydraulic properties of the alluvial aquifer and the extent of free-floating petroleum. Periodic gaging of the wells showed a significant change in groundwater elevations and petroleum thicknesses with tidal fluctuations. A 36-hour survey of petroleum and groundwater levels in the wells was conducted to quantify these changes. Based on the hydrogeologic assessment and operation of the petroleum recovery system, the following was concluded: (1) operation of the petroleum recovery system has significantly reduced petroleum seepage into the Penobscot River and the amount of petroleum on the groundwater; (2) tidal fluctuations influence the thickness of free-floating petroleum and the direction and rate of groundwater flow; (3) the petroleum recovery well is located in the area of greatest petroleum accumulation; and (4) as petroleum has been re-

moved from the vicinity of the recovery well, the water yield of the well has increased. This has resulted in a greater area of influence of the well. (See also W87-02497) (Lantz-PTT)
W87-02539

DEVELOPMENT OF AN ADEQUATE RCRA GROUND WATER MONITORING SYSTEM IN FRACTURED SEDIMENTARY BEDROCK: A CASE STUDY,
West Virginia Dept. of Natural Resources, Charleston. Div. of Water Resources.
J. E. Cibrik, and R. M. Melvin.
IN: Proceedings of the Fifth National Symposium and Exposition on Aquifer Restoration and Ground Water Monitoring, May 21-24, 1985, The Fawcett Center, Columbus, Ohio. 1985. p 734-750, 6 fig, 7 tab.

Descriptors: *Groundwater quality, *Monitoring, *Water pollution control, *Fracture permeability, *Sedimentary rocks, *Bedrock, Case studies, Legal aspects, Wells, Water quality control, Boreholes, Water sampling.

During the summer of 1983, 15 groundwater monitoring systems at facilities in the State of West Virginia were assessed for compliance with RCRA interim status regulations (40 CFR 265, Subpart F) by personnel from the Solid and Hazardous Waste/Ground Water (S&HW/GW) Branch of the Division of Water Resources, Department of Natural Resources. A paper was presented at last year's symposium which summarized the deficiencies noted in the 15 systems. This case study describes the steps taken to resolve the deficiencies in the monitoring system at one of these facilities. The company was notified of the deficiencies (i.e., sent a copy of the assessment report) and given a chance to respond. Following the company's response, an administrative order was issued which required the company to conduct a test boring program, install additional monitoring wells and sample the new wells. Based on the results of the test borings (core analysis, pressure tests, etc.), seven additional monitoring wells were installed. Throughout the well installation process, meetings were held and on-site decisions made regarding modifications to the approved plan. This included well location, pressure testing, sampling mechanisms, and well construction (screen length and location, depth, etc.). This paper provides the details of the previously installed and the new groundwater monitoring systems, the measures taken to provide the information required to design an adequate monitoring system, the basis for all decisions made, the problems encountered and the resolution of those problems. (See also W87-02497) (Lantz-PTT)
W87-02542

PILOT PLANT STUDIES OF TWO PROCESSES FOR OXIDATION OF AQUEOUS SULFIDE: PARADOX VALLEY UNIT, COLORADO RIVER BASIN SALINITY CONTROL PROJECT,
Bureau of Reclamation, Denver, CO. Engineering and Research Center.
W. J. Boegli, and A. P. Murphy.
Available from the National Technical Information Service, Springfield, VA. 22161 as PB86 230703, A06 in paper copy, A01 in microfiche. Report REC-ERC-84-18, October 1985. 97 p, 43 fig, 9 tab, 9 ref, 2 append.

Descriptors: *Pilot plants, *Oxides, *Sulfides, Salinity, Field tests, Brines, Paradox Valley, Colorado, Electrochemistry, Aeration, Sodium chloride, Groundwater quality, Water quality control, Sodium hypochlorite.

This report presents results of field tests of two processes which show potential for use in oxidizing the sulfide contained in saturated sodium chloride groundwater at Paradox Valley, Colorado; the first involving electrochemical oxidation, and the second involving aeration with catalyst. In the first phase of the test program, aqueous sulfide, present in Paradox brine at a concentration of about 80 mg/L, was oxidized with sodium hypochlorite produced from existing brine at the site, using a commercially available seawater electrolytic cell. Results showed that the process was effective in oxidizing sulfide and other reduced sulfur species present to sulfate. However, attempts at controlling the process to yield a product of elemental sulfur were not successful. The actual power consumption required for complete oxidation of all reduced species to sulfate was 6.57 kW (2.90 Wh/L) compared to a calculated requirement of 6.39 kW (2.82 Wh/L). In a second phase of testing, statistically designed experiments were used to determine the effects of selected variables on the efficiency of a nickel catalyzed aeration processes for oxidizing sulfide in Paradox brine to elemental sulfur. Both a single-stage and a two-stage, continuous flow, concurrent aeration system were evaluated. Results indicated more efficient oxidation using a second aeration stage with total sulfide removals exceeding 95% for 17 of 30 tests runs compared to 90% for 16 of 74 runs using a single stage. These tests also showed that diffuser fouling by precipitates formed in the oxidation process may be a problem in long-term operation. (Author's abstract)
W87-02549

NATURE CONSERVATION,
S. Selendy.
IN: Pollution Control and Conservation, Ellis Horwood Ltd., Chichester, England, 1985. p 308-347, 2 tab.

Descriptors: *Conservation, *Management planning, Water conservation, Soil conservation, Recreation, Geological formations, Rivers, Lakes, Forests.

The concept of nature conservation comprises the protection and preservation of natural resources of scientific or cultural significance. Their development and preservation are the primary task of nature conservation, in a limited sense, as opposed to the so-called general nature conservation which refers to the entire natural world and is considered to be a task of secondary important in this context. The subjects of nature conservation are natural sites of special interest, such as (a) geological formations (mountains, rock formations, caves, ravines, etc.) and waters (source, brook, river, waterfalls, lake, marsh-land, etc.); (b) plants and plantations living in a wild state (plant species, tree avenues, forests, other plant societies, parks, arboreta, etc.); (c) wild animal species which owing to their rarity or peculiarity are of interest or species facing extinction; (d) territories and landscape segments which, owing to their characteristic or favorable natural features, are of special significance. The primary aim of nature conservation is to preserve and maintain the most important natural resources - in a certain state or rather in a definite process of change - for scientific research and for education and popular science. In order to do this, harmful human and natural impacts are to be eliminated or reduced to a minimum. The second goal of natural conservation is the maintenance of the cultural-social functions of the protected natural sites. Recently, the third aim - mainly of economic character - is the preservation of natural conditions, ensuring the survival of the plant and animal species which constitute our genetic resources. How nature conservation is being attempted in may areas of Hungary is presented. (See also W87-02553) (Lantz-PTT)
W87-02560

SALTY COLORADO,
John Muir Inst. for Environmental Studies, Inc., Napa, CA.
For primary bibliographic entry see Field 5B.
W87-02561

6. WATER RESOURCES PLANNING

6A. Techniques Of Planning

PROBLEMS OF THE ECOLOGICAL TRANSFORMATION OF RESOURCE USE AND THE DEVELOPMENT OF ECOLOGICAL EVALUATION,
Bulgarian Ecological Society, Svishtov.
K. Marinov.
Soviet Journal of Ecology SJECAH, Vol. 16, No. 4, 195-200, July/August 1986. 4 ref. Translated from Ecologiya, Vol. 16 , No. 4, p 11-18, July-August 1985.

Descriptors: *Impact assessment, *Ecological effects, *Management planning, *Cost analysis, Landscape, Geography, Urban planning, Economics, Risk assessment, Black Sea, Danube, Soviet Union, Public health.

Ecological evaluation (EE) is defined as activity to identify an actual or potential impact of industrial production on the environment. EE must focus on questions of the ecological utility and effectiveness of planned economic measures, the prevention of gross disturbances in ecological equilibrium, and their requirements of conservation legislation. It follows from the comprehensive nature of the anthropogenic load that the EE itself should be comprehensive and include several subsystems: (1) bioecological, (2) landscape-geographic, (3) demographic, (4) city planning, and (5) sanitary-hygienic, etc. The perfection of EE presupposes the development of ecological and physicochemical methods for analyzing industrial impact and its long-term consequences. Under current conditions, the EE involves four main stages: (1) analysis of initial information on planned economic activity and the ecological conditions of a given area or region, (2) detection of possible factors of increase in ecological risk, (3) analysis of likely consequences from ecological-economic viewpoints, and (4) development of recommendations for optimizing initial type of activity or its complete reexamination. Ecological problems in the development of the Black Sea and Danube territorial complexes are discussed. (Rochester-PTT)
W87-01858

UTILIZATION OF MODELS IN WATER RESOURCES,
Iowa State Water Resources Research Inst., Ames.
T. A. Austin.
Water Resources Bulletin WARBAQ, Vol. 22, No. 1, p 49-56, February 1986. 5 tab, 2 ref, append.

Descriptors: *Mathematical models, *Systems analysis, *Surveys, Model utilization,, Planning, Design criteria, Operations, Computers, Surface water hydrology, Surface water quality, Streamflow, Precipitation, Infiltration, Evapotranspiration, Groundwater quality.

A 1984 survey of water resources personnel was conducted to determine the current and future uses of mathematical models in planning, design and operations of water resources systems. Eighty-six percent of those responding indicated they have used mathematical models in the last year. Lack of appropriate data, inadequate time and funding to do the modeling and lack of models that represent the 'real world' situation were the most frequently mentioned constraints to model use. Microcomputers were seen as having a positive influence on mathematical model use in water resources. The various types of mathematical models used include: surface water hydrology, surface water quality, hydraulic (channel and tidal), reservoir systems, groundwater hydrology, water supply use and demand, economic, pipe networks, wastewater treatment, conjunctive use, groundwater quality, water transportation, irrigation and irrigation scheduling, and water treatment. The ranking of priority for additional data collection efforts to provide the greatest improvement in model use by both state agencies and private consultants include: streamflow, surface water quality, groundwater levels, groundwater quality, evapotranspiration, infiltration, and precipitation. (Peters-PTT)
W87-01887

APPLICATION OF A LOW-FLOW ASSESSMENT MODEL FOR THE MONONGAHELA RIVER BASIN,
CH2M Hill International Corp., Gainesville, FL.

L. G. Rhue, and M. J. Small.
Water Resources Bulletin WARBAQ, Vol. 22, No. 1, p 121-127, February 1986. 8 fig, 2 tab, 24 ref.

Descriptors: *Reservoirs, *Synthetic hydrology, *Low flow, Reservoir operation, Monongahela River, Pennsylvania, West Virginia, Maryland, Consumptive use, Limitation policies, Pool levels, Mathematical models.

The application of a low-flow assessment model is illustrated for the Monongahela River Basin, an area of approximately 7300 sq miles, including parts of Pennsylvania, West Virginia, and Maryland. The model simulates the impact of reservoir operating rules and consumptive use limitation policies on low-flow frequency at downstream locations in the basin. The major inputs to the Monongahela simulation model include daily subbasin flows at each of the three major reservoir inflow locations and daily unregulated flows at each of nine downstream stations. The model was tested by comparing historical observed flows with flows predicted using the reservoir operating policies for the Tygart and Youghiogheny Reservoirs. The examination of a consumptive use make-up requirement indicates that little benefit could be attained through implementation of this policy, unless increases in consumptive use were to occur in the future. Raising the summer pool level of the Tygart Reservoir with observed flow records as input resulted in an increase in the 7-day, 10-year low flow, but little change in the 50-year flood. Lowering the pool level decreased both values. With synthetic uncontrolled flows as input, however, increased values for both floods and low flows were predicted when the summer pool level was raised. The analysis with synthetic flow records suggests that, within the framework of the operating rules considered, improved drought protection in the Monongahela can only be obtained at the cost of decreased flood protection. (Peters-PTT)
W87-01895

POTENTIAL BENEFITS AND COSTS OF IN-GROUND STORAGE OF IMPORTED WATER,
Arizona State Univ., Tempe. Dept. of Economics.
For primary bibliographic entry see Field 6C.
W87-01896

APPLICATION OF MATHEMATICAL PROGRAMMING IN PLANNING SURFACE WATER STORAGE,
Arizona Univ., Tucson. Dept. of Hydrology and Water Resources.
For primary bibliographic entry see Field 2E.
W87-01936

IDENTIFICATION OF WATER QUALITY DIFFERENCES IN NEVADA THROUGH INDEX APPLICATION,
Nevada Univ., Reno. Dept. of Plant, Soil and Water Science.
For primary bibliographic entry see Field 5G.
W87-02091

ENVIRONMENTAL IMPACT ASSESSMENT: 'PSEUDOREPLICATION' IN TIME,
California Univ., Santa Barbara. Dept. of Biological Sciences.
For primary bibliographic entry see Field 6G.
W87-02104

GROUND WATER PLAN HAS REGIONAL FOUNDATION,
Kellogg Corp., Littleton, CO.
J. L. Moorhouse.
Water Engineering and Management WENMD2, Vol. 133, No. 7, p 27-28, July 1986.

Descriptors: *Groundwater management, *Water quality management, *Regional planning, *California, Wastewater disposal, Water permits.

California's approach to regional level responsibility for groundwater quality protection is reviewed. Information requirements for development of regional water quality control plans are identified. Procedural requirements and review processes governing waste discharge permits are also discussed. (Michael-PTT)
W87-02108

SCREENING MODEL FOR DEVELOPMENT AND EVALUATION OF ACID RAIN ABATEMENT STRATEGIES,
Waterloo Univ. (Ontario). Dept. of Civil Engineering.
For primary bibliographic entry see Field 5G.
W87-02111

EVOLVING FRAMEWORK FOR ENVIRONMENTAL IMPACT ANALYSIS. I. METHODS,
Maritime Testing (1985) Ltd., Dartmouth (Nova Scotia). Environmental Div.
For primary bibliographic entry see Field 6G.
W87-02113

EVOLVING FRAMEWORK FOR ENVIRONMENTAL IMPACT ANALYSIS: II. APPLICATIONS,
Maritime Testing (1985) Ltd., Dartmouth (Nova Scotia). Environmental Div.
For primary bibliographic entry see Field 6G.
W87-02114

UNCERTAINTY IN DEMAND FORECASTING AND ITS CONSEQUENCES IN WATER RESOURCE PLANNING: THE TEESSIDE EXPERIENCE,
Northumbrian Water Authority, Gosforth (England).
For primary bibliographic entry see Field 6D.
W87-02267

RISK MANAGEMENT OF GROUNDWATER CONTAMINATION IN A MULTIOBJECTIVE FRAMEWORK,
Bell Communications Research, Inc., Holmdel, NJ.
For primary bibliographic entry see Field 5G.
W87-02286

RESERVOIR MANAGEMENT AND OPERATIONS MODELS: A STATE-OF-THE-ART REVIEW,
California Univ., Los Angeles. Dept. of Civil Engineering.
W. W.-G. Yeh.
Water Resources Research WRERAQ, Vol. 21, No. 12, p 1797-1818, December 1985. 224 ref. NSF Grant CEE-8113500.

Descriptors: *Computer models, *Mathematical models, *Reservoir operation, Simulation, Simulation analysis, Stochastic process, Probabilistic process, Water management, Optimization, Systems analysis, Linear programming, Dynamic programming, Nonlinear programming, Computer programs.

Several optimization methods and computer-based models for reservoir management and operational simulation are reviewed. Linear programming (LP) methods include chance-constrained LP, stochastic LP and stochastic programming with recourse. Dynamic programming (DP) methods include incremental and discrete differential DP, incremental DP and successive approximations, stochastic, reliability-constrained and differential DP and the progressive optimality algorithm. Nonlinear programming and simulation models are also described. Application of these methods and models to real time operations of several water projects is examined and recommendations for further research in optimization techniques are proposed. (Michael-PTT)
W87-02296

INPUT-OUTPUT MODELS, ECONOMIC SURPLUS, AND THE EVALUATION OF STATE OR REGIONAL WATER PLANS,
Colorado State Univ., Fort Collins. Dept. of Agricultural and Natural Resource Economics.
R. A. Young, and S. L. Gray.
Water Resources Research WRERAQ, Vol. 21, No. 12, p 1819-1823, December 1985. 34 ref.

Descriptors: *Input-output analysis, *Regional planning, *Cost-benefit analysis, Water costs, Economic evaluation, Economic justification, Economic efficiency, Estimating equations, Mathematical models.

Adaptation of input-output models for cost-benefit analysis of state or regional water plans is discussed. The economic surplus approach is considered appropriate for evaluation of regional and national water programs. A conceptual framework based on a willingness to pay concept is developed to provide a formula for estimating direct economic benefits of state water development plans using input-output models. Key elements of this formula are the costs of primary resources such as capital, labor, management and land. A number of influential empirical studies are shown to incorrectly account for opportunity costs facing water users in producing sectors, thus resulting in erroneously high measurements of the economic benefits of water projects. (Michael-PTT)
W87-02297

OPTIMAL MULTIRESERVOIR NETWORK CONTROL BY THE DISCRETE MAXIMUM PRINCIPLE,
Dorsch Consult G.m.b.H., Munich (Germany, F.R.).
M. Papageorgiou.
Water Resources Research WRERAQ, Vol. 21, No. 12, p 1824-1830, December 1985. 3 fig, 1 tab, 12 ref, 2 append.

Descriptors: *Optimization, *Control systems, *Multireservoir networks, Mathematical equations, Computer models, Computer programs, Reservoir operations.

An optimal control algorithm based on the discrete maximum principle is applied to multireservoir network control operations. Variable metric techniques are used to solve the resulting two-point boundary value problem. State variable constraints are considered by the use of penalty functions. This algorithm requires only minimum computer time and data storage space which increases linearly with the problem dimension. Application to an example ten-reservoir network demonstrates the efficacy of this algorithm. (Author's abstract)
W87-02298

VARIABILITY OF ALTERNATIVE DECISIONS IN A WATER RESOURCES PLANNING PROBLEM,
Harvard Univ., Cambridge, MA. Div. of Applied Sciences.
J. J. Harrington, and J. S. Gidley.
Water Resources Research WRERAQ, Vol. 21, No. 12, p 1831-1840, December 1985. 8 fig, 4 tab, 18 ref, append.

Descriptors: *Optimization, *Planning, *Decision making, Computer models, Linear programming, Mathematical equations, Economic evaluation.

The use of methods for generating nearly optimal solutions to linear programming models is illustrated in an example problem involving the sizing of reservoirs and hydroelectric power plants and demands for municipal water supply and irrigation. Interactions among the decision variables and the economics of the system determine the range of choices among nearly optimal decisions. Examination of these interactions illustrates the basic structure of the decision problem. (Michael-PTT)
W87-02299

SHENANDOAH WATERSHED STUDY: CALIBRATION OF A TOPOGRAPHY-BASED, VARIABLE CONTRIBUTING AREA HYDROLOGICAL MODEL TO A SMALL FORESTED CATCHMENT,
Virginia Univ., Charlottesville. Dept. of Environmental Sciences.

G. M. Hornberger, K. J. Beven, B. J. Cosby, and D. E. Sappington.
Water Resources Research WRERAQ, Vol. 21, No. 12, p 1841-1850, December 1985. 6 fig, 6 tab, 32 ref.

Descriptors: *Shenandoah National Park, *Hydrologic models, *Catchment areas, *Forest watersheds, *Calibrations, *Topography, Hydrologic data, Mathematical models, Parametric hydrology, Simulation analysis, Sensitivity analysis.

A topography-based, variable contributing area model (TOPMODEL) of catchment hydrology was adapted for continuous simulation and extended to account for observed processes in a small forested catchment area in the Shenondoah National Park, Virginia. Automatic calibrations were attempted using eight different objective functions. These were indifferent to many of the model parameters and thus parameter estimation was unreliable. The original model structure was simplified on the basis of results from a regionalized sensitivity analysis. The parameters of the simplified model produced fits to the measured data nearly as well as the more complex version and were well estimated using a sum of squared errors criterion. (Author's abstract)
W87-02300

COMPUTATIONALLY EFFICIENT ALGORITHMS FOR PARAMETER ESTIMATION AND UNCERTAINTY PROPAGATION IN NUMERICAL MODELS OF GROUNDWATER FLOW,
Western Australia Univ., Nedlands. Centre for Water Research.
For primary bibliographic entry see Field 2F.
W87-02301

TESTING FLOOD FREQUENCY ESTIMATION METHODS USING A REGIONAL FLOOD GENERATION MODEL,
Washington Univ., Seattle. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2E.
W87-02306

USE OF SYSTEMS ANALYSIS IN WATER MANAGEMENT,
Harvard Univ., Cambridge, MA.
P. P. Rogers, and M. B. Fiering.
Water Resources Research WRERAO, Vol. 22, No. 9, p 146S-158S, August 1986. 2 fig, 5 tab, 23 ref. NSF Contract CEE 8305320.

Descriptors: *Systems analysis, *Water management, *Water resources development, *Model studies, Mathematical studies, Project planning, Databases.

Over the past 30 years systems analysis applied to the planning and operation of water resource systems has grown from a mathematical curiosity to a major specialty. Systems analysis is that set of mathematical planning and design techniques which includes at least some formal optimization procedure. Based on the increasingly large number of systems-oriented papers which appear in the civil engineering literature, it is not unreasonable to expect that the use of one or another optimization technique would have been undertaken in a significant number of completed projects and described in the literature; this turns out not to be the case. Moreover, U.S. federal agencies and major consultants do not appear to use these techniques in any but a handful of projects. Several explanations are offered for this, including institutional resistance to use of the techniques, deficiencies in databases, inadequacies in modeling, and the fundamental insensitivity of many systems (not merely the models thereof) to wide variations in design choices. The differences between application in developed and developing countries are explored. (Author's abstract)
W87-02323

HYDROGEOLOGIC PLANNING FOR THE NESHAMINY CREEK BASIN, SOUTHEASTERN PENNSYLVANIA,
Neshaminy Water Resources Authority, Jamison, PA.
J. K. Adams, and T. H. Cahill.
IN: The Second Annual Eastern Regional Ground Water Conference, July 16-18, 1985, Portland, Maine. 1985. p 557-579, 8 fig, 2 tab, 10 ref.

Descriptors: *Geohydrology, *Neshaminy Creek, *Water resources development, *Regional planning, Groundwater development, Mapping, Data acquisition, Computers, Surface flow, Aquifers, Groundwater movement, Groundwater quality, Groundwater potential, Pennsylvania, Monitoring, Management planning.

The study of groundwater resources in the upper Neshaminy Basin Pennsylvania began with a detailed review of that which is known: the surficial geology, as mapped and studied in several USGS publications, and a partial record of existing wells and their performance, as described in these and other USGS studies. The first step in the work plan, then, was to develop a computer-based record of all existing available wells, geo-coded by UTM coordinates so that the information developed as to aquifer depth, water table, yield and other parameters can be plotted and mapped by computer, in conjunction with topographic and other land resource data. The second step in the groundwater study program is to establish and maintain a selected group of surface water flow measurement stations, to develop the hydrologic record necessary to establish the 'base flow' of streams draining various aquifers. The third step in the groundwater study program consists of a series of special studies in selected areas, designed to evaluate the existing conditions of groundwater use in different aquifers, different patterns of development, and other complicating factors, such as storm and sanitary sewerage. The fourth step is related to the issue of monitoring groundwater levels, and includes the installation of level measuring and recording devices at selected large wells, not presently in use, such as exist in several of the municipal systems. A fifth step is a rather specialized study of existing quarries which are situated within the upper basin, and represent valuable information as to groundwater drainage, water table fluctuations and pumping rates from selected geologic formations. The Neshaminy Basin reflects many of the pressing issues with respect to groundwater management, including the lack of detailed scientific knowledge as to the potential of the resource and the popular misconceptions which hamper groundwater utilization. If this resource is to be protected, maintained and use increased, energies must be invested to answer the technical questions and confront the political issues. (See also W87-02437) (Lantz-PTT)
W87-02475

6B. Evaluation Process

MISSISSIPPI-ATCHAFALYA DIVERSION: A NEW PERSPECTIVE,
J. D. Martinez.
Bulletin of the Association of Engineering Geologists, Vol. 23, No. 1, February 1986. 6 fig, 12 ref.

Descriptors: *Engineering geology, *Diversion structures, *Mississippi River, *Atchafalaya River, *Meanders, Control structures, Transportation, Flood damage, Profit Island, Baton Rouge, New Orleans, Cost-benefit analysis, Cost analysis, Diversion channels, Channels.

Contrasting views of a potential Mississippi River diversion were presented in 1980. Dire results were predicted from a future failure of the Old River Control Structure, which was constructed to prevent diversion of the Mississippi by the Atchafalaya. Losses were estimated in transportation facilities, flood damage, and pipe line failure, ranging from 1.562 to 4.025 billion dollars. It was also suggested that a controlled and managed diversion of substantial duration be considered, while the U. S. Army Corps of Engineers has plans to modify the existing Old River Structure complex to ensure its continued success in flow control, at an estimated cost of 220 million dollars. There is an alternative to these three options which could work in harmony with natural processes in avoiding a capture of the Mississippi by the Atchafalaya for perhaps thousands of years. This approach involves significantly shortening the current 253 mile path of the Mississippi River from Profit Island, near Baton Rouge, to Head of Passes, by constructing five meander loop cutoffs in this stretch, along with a diversion of the Mississippi River just east of New Orleans to Breton and chandeleur sounds, via the present Mississippi River Gulf Outlet. This would shorten the present distance by 82 miles or 32 percent and in essence re-establish the viability of the present channel. This proposal constitutes a concept rather than a derived conclusion. Hopefully, it will calm fears raised by catastrophic predictions and will focus the attention of appropriate governmental agencies on a continuing reappraisal of alternatives. (Author's abstract)
W87-01843

ASSESSMENT OF USES MADE OF A MULTI-PURPOSE RESERVOIR,
Ohio State Univ., Columbus.
T. L. Napier, S. M. Camboni, and W. R. Goe.
Water Resources Bulletin WARBAQ, Vol. 22, No. 1, p 11-18, February 1986. 2 fig, 3 tab, 33 ref.

Descriptors: *Social aspects, *Reservoirs, *Recreation, Attitudes, Local impacts, Mathematical models, Columbus, Ohio, Functional theory, Social exchange theory, Flood control, Water supply, Fish conservation, Wildlife conservation.

The attitudes of local people toward specific change stimuli in a rural community group disrupted by reservoir development are investigated. The change stimuli selected for study were the four uses made of every reservoir project: flood control, water supply, fish and wildlife conservation, and recreation. Two theoretical models were used to formulate the study hypotheses: functional theory, an adaptation perspective; and social exchange theory, a vested interest perspective. The community selected for research is located in the urban fringe of Columbus, Ohio. Research was initiated in 1974 and repeated in 1980. All of the reservoir uses were perceived to be somewhat favorable in 1974 with the exception of recreation which was perceived to be slightly negative. In 1980 all of the uses were perceived quite favorably, although recreation use of the reservoir was the least favored. The perceived costs, perceived benefits, and perceptions of recreationists were all significantly related with the attitudes toward the four uses of the reservoir. As perceived costs associated with the reservoir project increased there was a concomitant decrease in favorable attitudes toward the four uses evaluated. As perceived benefits and positive perceptions of recreationists increased, there were concomitant increases in perceptions of favorability for all four uses evaluated. The correlations were moderate in terms of strength of association. It is concluded that the four uses of the lake assessed in this study have not adversely affected local people because local people are positive about the uses. (Peters-PTT)
W87-01882

UTILIZATION OF MODELS IN WATER RESOURCES,
Iowa State Water Resources Research Inst., Ames.
For primary bibliographic entry see Field 6A.
W87-01887

FEW PROBLEMS WITH WATER ENCOUNTERED IN BRAZIL (QUELQUES PROBLEMES DE L'EAU ENCONTRES AU BRESIL),
Office de la Recherche Scientifique et Technique Outre-Mer, Paris (France).
For primary bibliographic entry see Field 5F.
W87-01967

MANAGING WATER,
Water Industry Training Association, Tadley (England).
For primary bibliographic entry see Field 5F.
W87-02046

FEDERAL EVALUATION OF STRIPMINE RECLAMATION,
Environmental Protection Agency, Philadelphia, PA. Region III.
For primary bibliographic entry see Field 5E.
W87-02067

WETLAND VALUES AND PROTECTION STRATEGIES: A STUDY OF LANDOWNER ATTITUDES IN SOUTHERN ONTARIO,
Guelph Univ. (Ontario). Dept. of Geography.
R. D. Kreutzwiser, and L. J. Pietraszko.
Journal of Environmental Management JEVMA, Vol. 22, No. 1, p 13-23, January 1986. 5 fig, 4 tab, 15 ref.

Descriptors: *Wetlands, *Water policy, *Ontario, *Public opinion, *Protection, *Value, Education, Land use, Statistical analysis.

Rural wetland owners in southern Ontario were surveyed regarding attitudes toward wetland values and wetland protection methods. The relationship between attitudes toward wetlands and their protection methods and landowners/land base characteristics was also determined. Landowners appeared, for the most part, to have a restricted awareness of wetlands value. Paired comparison analysis of preferences for protection methods indicated a majority preference for methods that are least stringent such as education-advisory services and property tax incentives. A number of factors are important in discriminating differences in attitudes. Landowner characteristics appear to cause differences in attitudes toward wetlands value, while land base attributes seemed to affect preferences for protection methods. (Michael-PTT)
W87-02116

ECONOMIC LOSSES TO RECREATIONAL FISHERIES DUE TO SMALL-HEAD HYDROPOWER DEVELOPMENT: A CASE STUDY OF THE HENSY'S FORK IN IDAHO,
California Univ., Davis. Div. of Environmental Studies.
J. Loomis, C. Sorg, and D. Donnelly.
Journal of Environmental Management JEVMA, Vol. 22, No. 1, p 85-94, January 1986. 1 fig, 29 ref.

Descriptors: *Sport fishing, *Hydroelectric plants, *Idaho, *Economic impact, Economic evaluation, Prediction, Dams, Feasibility studies, Licensing, Recreation, Estimating, Benefits, Statistical analysis, Federal Energy Regulatory Commission, Fisheries.

Economic losses that could result if fishing quality dropped by 50% due to small-head hydroelectric power development on Henry's Fork of Idaho's Snake River are estimated by applying the Travel Cost and Contingent Value Methods to a survey of anglers. A 50% reduction in fish catch would result in an annual loss of $920,000 in fishing benefits, while a similar reduction in the size of fish caught would result in a loss of $1.07 million in fishing benefits. It is recommended that quantification of foregone fisheries benefits be routinely required for all proposed small-head hydroelectric projects and that the Federal Energy Regulatory Commission use such information to determine overall project feasibility during the hydro power permitting process. (Michael-PTT)
W87-02117

SUPPLY SIDE ENGINEERING,
R. Robison.
Civil Engineering, Vol. 56, No. 8, p 52-55, August 1986. 4 fig.

Descriptors: *New Jersey, *Concrete dams, *Civil engineering, *Water supply development, Concrete mixing, Water utilities, Water companies, Reservoirs, Planning.

A public and an investor-owned water utility joint venture in the development and construction of a state-of-the-art roller compacted concrete (RCC) dam project to alleviate chronic water shortage problems in New Jersey's Passaic Valley. Dam construction and RCC seepage control measures are described, such as the superplasticized concrete used loose RCC spread, internal collection drains and spillway design. The project provides for interconnection between two reservoirs. The planning, contracting and financial arrangements involved in co-tenancy of water projects are discussed. (Michael-PTT)
W87-02261

UNCERTAINTY IN DEMAND FORECASTING AND ITS CONSEQUENCES IN WATER RESOURCE PLANNING: THE TEESSIDE EXPERIENCE,
Northumbrian Water Authority, Gosforth (England).
For primary bibliographic entry see Field 6D.
W87-02267

HYDROELECTRIC RESOURCE STUDIES IN TOGO AND BENIN,
For primary bibliographic entry see Field 7A.
W87-02268

DISTINCT POLICY WHICH FORMS A MARKET WITHIN THE CALIFORNIA STATE WATER PROJECT,
American Telephone and Telegraph Co., Morristown, NJ.
For primary bibliographic entry see Field 6E.
W87-02285

POLICY EVALUATION TOOL: MANAGEMENT OF A MULTIAQUIFER SYSTEM USING CONTROLLED STREAM RECHARGE,
Geological Survey, San Diego, CA.
W. R. Danskin, and S. M. Gorelick.
Water Resources Research WRERAO, Vol. 21, No. 11, p 1731-1747, November 1985. 11 fig, 1 tab, 21 ref, 2 append.

Descriptors: *Water policy, *Aquifers, *Water management, Water allocation, Livermore, Reservoir operation, Mathematical models, Mathematical equations, Basins, Economic incentives, Stream discharge, Optimization, Water costs, Decision making.

A water resources allocation optimization model was developed for a multiaquifer system near Livermore, CA. The system was analyzed using a transient, quasi-three-dimensional model that considers the nonlinear behavior of the unconfined aquifer. The surface water system consists of a reservoir that discharges into three streams which recharge the upper aquifer. Nonlinear streamflow-recharge relationships were developed based on synoptic field measurements of streamflow. Constrained optimization was used to minimize costs of allocating water subject to physical and economic restrictions. This combined hydrological and economic management model can be used to evaluate management practices of a complex water system. The utility of the model is demonstrated through evaluation of intra-basin water allocation efficiency and identification of critical factors influencing management decisions and the effects of economic incentives that can be used to satisfy conflicting objectives of various water users. (Author's abstract)
W87-02287

INPUT-OUTPUT MODELS, ECONOMIC SURPLUS, AND THE EVALUATION OF STATE OR REGIONAL WATER PLANS,
Colorado State Univ., Fort Collins. Dept. of Agricultural and Natural Resource Economics.
For primary bibliographic entry see Field 6A.
W87-02297

USE OF SYSTEMS ANALYSIS IN WATER MANAGEMENT,
Harvard Univ., Cambridge, MA.
For primary bibliographic entry see Field 6A.
W87-02323

DILETTANTISM IN HYDROLOGY: TRANSITION OR DESTINY,
National Hydrology Research Inst., Ottawa (Ontario).
V. Klemes.
Water Resources Research WRERAO, Vol. 22, No. 9, p 177S-188S, August 1986. 5 fig, 31 ref.

Descriptors: *Hydrology, *Theoretical analysis, Hydraulic engineering, Geohydrology, Geology, Geography, Research needs, Water management, Computers.

The unsatisfactory state of hydrology is, in the final analysis, the result of the dichotomy between the theoretical recognition of hydrology as a science in its own right and the practical impossibility of studying it as a primary discipline but only as an appendage of hydraulic engineering, geography, geology, etc. As a consequence, the perspectives of hydrologists tend to be heavily biased in the direction of their nonhydrologic primary disciplines and their hydrologic backgrounds have wide gaps which breed a large variety of misconceptions. This state of affairs often paralyzes hydrologists' ability to differentiate between hydrology and water management, hydrology and statistics, facts and assumptions, science and convenience, etc., with consequent dangers both to scientific development of hydrology and to its practical utility. The danger increases with the proliferation of computerized 'hydrologic' models whose cheaply arranged ability to fit data is presented as proof of their soundness and as a justification for using them for user-attractive but hydrologically indefensible extrapolations. These points are illustrated, among other things, by a discussion of flood frequency analysis. The paper concludes with some thoughts concerning minimum standards for the testing of hydrologic simulation models that would ensure at least a modest level of credibility, and with a few suggestions for ingredients of a long-term cure that can prevent hydrology from joining alchemy and astrology in the annals of dilettantism. (Author's abstract)
W87-02326

MANAGING GROUND WATER SUPPLIES IN A SOLE SOURCE AQUIFER,
S E A Consultants, Inc., Boston, MA.
For primary bibliographic entry see Field 4B.
W87-02474

6C. Cost Allocation, Cost Sharing, Pricing/Repayment

EFFICACY AND COST OF AQUATIC WEED CONTROL IN SMALL PONDS,
Florida Univ., Gainesville. Dept. of Fisheries and Aquaculture.
J. V. Shireman, D. E. Colle, and D. E. Canfield, Jr.
Water Resources Bulletin WARBAQ, Vol. 22, No. 1, p 43-48, February 1986. 5 tab, 14 ref. EPA Grant R-805497; USDA Cooperative agreement 58-7830-0-177.

Descriptors: *Aquatic plants, *Fish ponds, *Macrophytes, Welaka,, Florida, Herbicides, Grass carp, Fertilization, Economic aspects.

The long-term efficacy and costs of managing aquatic vegetation in small Florida sportfishing ponds are studied. Three management techniques are compared: fertilization, aquatic herbicides, and grass carp. The study was conducted at Welaka (Putnam County), Florida, in 24 square 0.2-hectare ponds. Ponds used for herbicide and grass carp treatments were managed at three levels of aquatic vegetation (none, 40, and 70 percent plant occupation). Submersed vegetation was not controlled with inorganic fertilization. Vegetation levels were maintained for less than 30 days after mechanical harvesting. Submersed macrophytes were not completely eliminated with herbicides, but the herbicide treatments utilized were effective at maintaining aquatic vegetation above 30 percent pond volume occupation. Grass carp consumed all species of submersed vegetation at the stocking densi-

ties used; therefore, planned levels of submersed macrophytes were not maintained. Grass carp did not consume all floating leaf vegetation, but after four years some grass carp ponds did have lower densities of floating leaf plants. Fertilization costs were $608/hectare/ year, and mechanical harvesting costs were $1979/hectare/year. Herbicide costs for the different treatment levels ranged from $417/hectare/year to $1339/hectare/year over the four-year period. Grass carp were the most economical vegetation control measure tested, with costs ranging from $159/hectare/year to $248/hectare/year for the four-year study. (Peters-PTT)
W87-01886

THEORETICAL FRAMEWORK OF FLOOD INDUCED CHANGES IN URBAN LAND VALUES,
Iowa Univ., Iowa City. Dept. of Geography.
G. A. Tobin, and T. G. Newton.
Water Resources Bulletin WARBAQ, Vol. 22, No. 1, p 67-71, February 1986. 5 fig, 16 ref.

Descriptors: *Floods, *Land appraisals, *Economic aspects, Urban economics, Hazards, Capitalization, Floodplains, Theoretical framework.

By integrating literature from flood hazard research and urban economics a theoretical structure is developed to explain changes in residential land values following flood events. The negative aspects of the flood hazard are capitalized in the value of the property. Land values (i.e., capitalization) vary both spatially across the floodplain and temporally depending on the frequency, severity, and spatial characteristics of the flood event. Previous work in this area has not addressed the capitalization process explicitly and has not specifically examined the ability of the land market to recover. This may account for the contradictory findings in the published literature. (Author's abstract)
W87-01889

APPLICATION OF A LOW-FLOW ASSESSMENT MODEL FOR THE MONONGAHELA RIVER BASIN,
CH2M Hill International Corp., Gainesville, FL.
For primary bibliographic entry see Field 6A.
W87-01895

POTENTIAL BENEFITS AND COSTS OF IN-GROUND STORAGE OF IMPORTED WATER,
Arizona State Univ., Tempe. Dept. of Economics.
D. E. Agthe.
Water Resources Bulletin WARBAQ, Vol. 22, No. 1, p 129-131, February 1986. 6 ref.

Descriptors: *Water supply, *Water storage, *Economic aspects, Planning, Importation, Property values, Saline water intrusion.

The potential economic costs and benefits of storing imported water are discussed. The costs may include property right acquisition, pumping costs for recharge and recovery, risk permiums for potential flooding of other property, the cost of defining rights to the aquifer, protection for the stored water, capital outlays for canals, dikes and similar structures, and social opportunity costs of the capital invested. Intermediate sites have potential additional costs of compensating the affected communities for losses in property values and economic growth potential, as well as the costs incurred for recovering water to be later evaporated during shipment in an open canal. The benefits may include prevention of subsidence and saltwater intrusion, savings on surface improvements, and more economic land use. (Peters-PTT)
W87-01896

ESTIMATES OF THE ECONOMIC VALUE PRODUCTIVITY OF IRRIGATION WATER IN PAKISTAN FROM FARM SURVEYS,
Agency for International Development, Karachi (Pakistan).
R. Z. Hussain, and R. A. Young.
Water Resources Bulletin WARBAQ, Vol. 21, No. 6, p 1021-1027, December 1985. 4 tab, 16 ref.

Descriptors: *Cost analysis, *Irrigation, *Salinity, *Water management, Pakistan, Farming, Agriculture.

Data from two cross-sectional surveys totalling over 2000 farmers in Pakistan are analyzed with regression techniques to estimate the value productivity of irrigation water and related resources. Returns to irrigation water vary by province, but in general are found to be high relative to estimated costs of obtaining water. Salinity of water supplies is an important productivity depressant. The results will be useful in determining the economic feasibility of various means for augmenting supplies and for improving delivery and application efficiencies. Irrigation water input showed extremely high returns relative to incremental cost. As efforts are made to improve existing water management practices, reduce water losses, and exploit the potential of groundwater, higher output can be anticipated. If the government can assure that inputs such as seed, fertilizer, pesticides, etc., are more easily available, further increased returns would be generated. (Peters-PTT)
W87-01937

RECENT SEWAGE FINANCING IN PENNSYLVANIA,
Collings, Legg, Mason, Inc., Philadelphia, PA.
H. Chapman.
Water Pollution Control Association of Pennsylvania Magazine, Vol. 19, No. 3, p 44, 48, May-June 1986.

Descriptors: *Financing, *Wastewater facilties, *Bond issues, *Pennsylvania, Interest rates, Oil prices.

Interest rate for municipal projects have declined from a high of 13.44% in 1982 to a low of 6.88% in March of 1986; for the next three years they should range between 6.75% and 8.50% for 10-yr and longer maturities. Lower oil prices are largely responsible for this decline in interest rates. Ten new bond issues by Pennsylvania municipalities are listed with brief project descriptions, interest rates, lengths of loans, and bond counsels. (Rochester-PTT)
W87-02072

FINANCING MUNICIPAL WATER SUPPLIES IN THE 1990'S,
Congressional Budget Office, Washington, DC.
For primary bibliographic entry see Field 5F.
W87-02495

6D. Water Demand

ACCURACY OF WATER USE FORECASTS: EVALUATION AND IMPLICATIONS,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Agricultural Economics.
C. T. Osborn, J. E. Schefter, and L. Shabman.
Water Resources Bulletin WARBAQ, Vol. 22, No. 1, p 101-109, February 1986. 5 tab, 12 ref.

Descriptors: *Forecasting, *Prediction, *Water use, *Water resources development, Senate Select Committee on National Water Resources, Water Resources Council, Water demand.

Forecasts of 1980 river basin water use presented in the reports of the 1960 Senate Select Committee on National Water Resources and in the Water Resources Council's First National Water Assessment of 1968 were compared to estimates of actual use in 1980 to assess the accuracy of efforts to forecast future water use. The majority of the forecasts were substantially in error. In general, the First National Assessment forecasts erred by a smaller margin, but tended to repeat the regional patterns of overestimation (underestimation) exhibited in the Senate Select Committee forecasts. Moreover, forecasts of the two groups that came within 20 percent of the 1980 withdrawals, in general were accurate, not because of superior prediction, but because of offsetting errors in forecast components. This performance leads to the conclusion that water use forecasts, regardless of the time-frame or the forecast method employed, are likely to be inaccurate. If such forecasting efforts are to be of value in contemporary water resources planning, forecasters should direct their attention toward methods which will illuminate the determinants of the demand for water. (Author's abstract)
W87-01893

EFFECTIVENESS OF DROUGHT POLICIES FOR MUNICIPAL WATER MANAGEMENT,
Nevada Univ., Reno. Dept. of Agricultural Economics.
R. Narayanan, D. T. Larson, and T. C. Hughes.
Water Resources Bulletin WARBAQ, Vol. 21, No. 3, p 407-416, June 1985. 6 fig, 5 tab, 13 ref. DOI Contract 14-34-0001-1271.

Descriptors: *Water use management, *Drought, *Municipal water, *Pricing, *Economic aspects, Utah, Rationing, Regression models, Precipitation, Household size.

During the 1976-77 drought, three principal mechanisms were used to reduce water use in Utah communities: price increases, maximum monthly use restrictions, and restrictions on outdoor watering times. The descriptive information on the programs and their effects in a variety of communities are integrated with a model that contributes to an overall understanding and more effective program design for future droughts. Water use reductions associated with different policies adopted by Utah communities are examined in order to establish the relative effectiveness of each of the rationing devices. A regression model was developed to explain observed changes in water use, with price, type of restriction, household size, and summer rainfall as independent variables. For an average system, a 1 percent increase in price would reduce water use by 0.07 to 0.09 percent. A 1 percent increase in outdoor watering time restriction reduces use by 0.064 to 0.075 percent. A 1 percent increase in quantity restrictions leads to a reduction in water use of 0.014 to 0.054 percent. The effectiveness of rationing policies is influenced by system characteristics. Outdoor watering time restrictions were less effective in systems with above average household size and below average monthly use. If distributional considerations are not important, price change is the better alternative since the marginal rate of substitution between water and all other goods used by households would remain equal. However, from the model, it appears that the short-run price elasticity is small and it might take a large increase in price to accomplish a reasonable reduction in use. A 20 percent reduction in water use would require more than doubling the price. (Peters-PTT)
W87-01912

DEMAND IRRIGATION SCHEDULE PILOT PROJECT: SRI LANKA,
California Polytechnic State Univ., San Luis Obispo. Dept. of Architectural Engineering.
For primary bibliographic entry see Field 3F.
W87-01949

ECONOMIC LOSSES TO RECREATIONAL FISHERIES DUE TO SMALL-HEAD HYDROPOWER DEVELOPMENT: A CASE STUDY OF THE HENSY'S FORK IN IDAHO,
California Univ., Davis. Div. of Environmental Studies.
For primary bibliographic entry see Field 6B.
W87-02117

UNCERTAINTY IN DEMAND FORECASTING AND ITS CONSEQUENCES IN WATER RESOURCE PLANNING: THE TEESSIDE EXPERIENCE,
Northumbrian Water Authority, Gosforth (England).
J. A. Brady.
Proceedings of Institutional Civil Engineers, PCIEAT, Vol. 78, No. 1, p 1383-1401, December 1985. 6 fig, 10 tab, 20 ref.

Descriptors: *Forecasting, *Industrial water, *Planning, *England, *Water demand, Industrial development, Regional development, History, Regional planning, Water resources development.

Requirements for water resources development to satisfy the domestic and industrial demands for raw and potable water in the Teesside region of northeast England are discussed. Developments before 1950 are used to establish the historical perspective on water demand forecasting. An urgent need for new industrial water resources led to the successful promotion of the Kielder water resources development project. Prevailing water demand at the time of the project is compared with the current decline in industrial development of the region to highlight some of the difficulties and uncertainties in forecasting future water demand in general and industrial water demand in particular. The consequences for water resources planning of this type of uncertainty is also discussed. (Michael-PTT)
W87-02267

VARIABILITY OF ALTERNATIVE DECISIONS IN A WATER RESOURCES PLANNING PROBLEM,
Harvard Univ., Cambridge, MA. Div. of Applied Sciences.
For primary bibliographic entry see Field 6A.
W87-02299

HYDROTHERMAL EXPLOITATION OF GROUNDWATER BY WATER-WATER HEAT PUMP, (L'EXPLOITATION HYDROTHERMIQUE DES NAPPES PAR POMPE A CHALEUR EAU-EAU),
Bureau de Recherches Geologiques et Minieres, Orleans (France).
For primary bibliographic entry see Field 4B.
W87-02422

1982 CENSUS OF MINERAL INDUSTRIES: WATER USE IN MINERAL INDUSTRIES.
Bureau of the Census, Washington, DC.
Available from the United States Government Printing Office, Washington, DC. 20402. Report MIC82-S-4, December 1985. 52 p, 9 tab, 4 append.

Descriptors: *Water use, *Industrial water, *Mineral industry, Mining, Oil industry, Process water, Data collections.

This report presents statistics on water intake, use, and discharge for establishments that indicated a quantity of water intake of 20 million gallons or more in their response to the 1982 Census of Mineral Industries. The statistics are for the year 1983. Data are collected and published for the year following the mineral industries census. Total water intake for establishments reporting water intake of 20 million gallons or more was 1,197.1 billion gallons in 1983. This represented 95% of the total water use estimated for mineral industries. Those establishments reporting water intake of 20 million gallons or more represent only 2% of the total number of mining establishments, 28% of the total number of persons employed in mining, and 52% of the value added in mining. Those establishments classified in Major Group 13, Oil and Gas Extraction, were the largest users of water in the mineral industries, reporting an intake of 601.6 billion gallons, 50% of the total. Of the total water intake for mineral industries, 44% was used in production or processing operation. Approximately 33% of the total water intake by mineral industries was from mine water. Of the total 1,036.7 billion gallons of water discharged, 68% was treated. Capital expenditures for the abatement of water pollutants were valued at 188.5 million dollars. Approximately 60% of the water intake in mineral industries was concentrated in 4 water resource regions; namely, the South Atlantic-Gulf, the Lower Mississippi, the Texas-Gulf and the California. Within the South Atlantic-Gulf region, Major Group 14, Nonmetallic Minerals, Except Fuels accounted for 90% of the water intake. In the Texas-Gulf and California regions, Major Group 13, Oil and Gas Extraction accounted for 89 and 83%, respectively. (Lantz-PTT)
W87-02543

6E. Water Law and Institutions

GROUNDWATER MANAGEMENT INSTITUTIONS IN KANSAS,
Kansas Univ., Lawrence. School of Law.
J. C. Peck.
Journal of Irrigation and Drainage Engineering (ASCE) JIDEDH, Vol. 112, No. 3, p 203-209, August 1986. 1 fig, 5 ref.

Descriptors: *Water yield improvement, *Groundwater management, *Kansas, *Legal aspects, *Administration, Groundwater, Water law, Public policy, Water management, Hydrology, Water rights, State jurisdiction, Permits.

The management of groundwater in Kansas through the statutory mechanism of the groundwater management district (GMD) is discussed. The law establishing GMDs has been in place for about 13 years, and has had a major impact on groundwater management in Kansas, primarily by shifting the focus of management from a statewide level to the local level. A description of the location of water in Kansas and of relevant state law is followed by discussions of the history of the development of the law establishing GMDs, their locations, their powers and how they have used them, and legal questions about these powers. Innovative measures being taken by GMDs include encouraging and coordinating efficiency testing of irrigation systems, disseminating information, attempting to require greater efficiency of water use systems, and helping designate intensive groundwater use control areas. Although it is too early to evaluate the success of the experiment, it is concluded that GMDs have added a degree of certainty to issuing water rights permits and have been the major factor in slowing down the number of permits being granted. (Doria-PTT)
W87-01950

WASHINGTON STATE'S REGULATION DILEMMA,
D. S. Hurlburt.
Water Well Journal, Vol. 40, No. 6, p 61-65, June 1986.

Descriptors: *Drilling, *Water wells, *Regulations, *Washington, Legislation, Licensing, Wells, Department of Ecology, Yakima County, Washington State Well Drillers Association, Inspectors.

In Washington State, particularly in Yakima County, a debate is in progress over how and how much to regulate the region's well drillers, with the drillers themselves on both sides of the issue. In 1984 Senate Bill 45-54 was introduced, but became stalled in committee; its proposals were: a mandatory 'start-up' card, required bonding for well drillers, and a two-year 'experience rating' required for each driller before licensure. Present regulations, based on the 1971 Drill Licensing Act, would be much more effective if they were properly enforced according to Kathryn Hansen, Executive Secretary of the Washington State Well Drillers Association. The state legislature approved two years ago, funds for four full-time regional geolgista/field investigators who work with the state Department of Ecology. The Senate water well advisory committee has recommended that DOE reassess minimum well construction standards and evaluate whether some new well contruction techniques, such as the use of polyvinyl chloride casings, should be permitted or disallowed. (Rochester-PTT)
W87-02075

NIAGARA LABYRINTH-THE HUMAN ECOLOGY OF PRODUCING ORGANOCHLORINE CHEMICALS,
Department of Fisheries and Oceans, Ottawa (Ontario). Chemical Hazards Div.
For primary bibliographic entry see Field 5G.
W87-02250

DISTINCT POLICY WHICH FORMS A MARKET WITHIN THE CALIFORNIA STATE WATER PROJECT,
American Telephone and Telegraph Co., Morristown, NJ.
M. M. Curie.
Water Resources Research WRERAO, Vol. 21, No. 11, p 1717-1720, November 1985. 10 ref. Calif. Univ., Davis Project UCAL-W-601.

Descriptors: *Project planning, *Water policy, *Economic evaluation, *California, Economic justification, Economic efficiency, Market value, Water law, Water rights, Water transfer.

The process involved in examining a water resources project such as that in California in an economic framework and to develop a proposal for market formation is reviewed. It has been suggested that California water rights markets must be created from the existing nonmarket water institution. In this case, the law does not need to be changed because appropriate conditions exist for market formation through codification of the project's water transfer policy. (Michael-PTT)
W87-02285

CONTEMPORARY SETTING FOR WATER MANAGEMENT IN THE WEST: AN OVERVIEW,
New Mexico Univ., Albuquerque.
R. G. Cummings.
Water Resources Research WRERAO, Vol. 21, No. 11, p 1749-1750, November 1985. 5 ref.

Descriptors: *Water management, *Water rights, *Judicial decisions, Water policy, Federal jurisdiction.

Several aspects of the judicial treatment of water rights issues and Federal-state relations are highlighted in this introduction to a collection of papers on the legal aspects of water rights and water allocation. (Michael-PTT)
W87-02288

OVERVIEW OF THE LAW OF GROUNDWATER MANAGEMENT,
Chicago-Kent Coll. of Law, IL.
A. D. Tarlock.
Water Resources Research WRERAO, Vol. 21, No. 11, p 1751-1766, November 1985. 104 ref.

Descriptors: *Groundwater management, *Legal aspects, *Water law, *Water conservation, Groundwater depletion, Arizona, Colorado, New Mexico, Judicial decisions, Constitutional law, Water shortage, Water rights, Commerce clause, Reviews.

The evolution of groundwater management law is reviewed. The legal regime governing the use of groundwater has evolved from a simple rule of capture to laws that require sharing among claimants who are within and outside of groundwater basins. Most of the legl change has occurred in the Far West, but eastern states are modifying existing water law in response to shortage situations and use conflicts. Arizona, Colorado and New Mexico have developed the msot sophisticated conservation requirements that limit groundwater use to improve extraction methods and move water to higher valued uses. A recent Supreme Court decision encourages conservation by subjecting groundwater to the negative commerce clause. This decision also has the effect of forcing states to justify conservation regimes that block out-of-state and in-state access to water resources. (Michael-PTT)
W87-02289

ALTERNATIVES AND UNCERTAINTIES IN INTERSTATE GROUNDWATER LAW,
New Mexico Univ., Albuquerque.
A. E. Utton.
Water Resources Research WRERAO, Vol. 21, No. 11, p 1767-1770, November 1985. 10 ref.

Descriptors: *Water law, *Groundwater management, *Equitable apportionment, Commerce clause, Constitutional law, Interstate waters, Federal jurisdiction, Water rights, Legal aspects.

The Supreme Court's use of the doctrine of equitable apportionment to resolve interstate water disputes and its application of the commerce clause to decide an interstate groundwater case are examined. Equitable apportionment requires consideration of equitable factors by a third-party decision maker in allocating interstate waters. Conversely, the commerce clause requires that the marketplace allocate interstate water uses. Equitable apportionment recognizes the equality of states under federalism while the commerce clause erases state boundaries. An integrated intersate water law is preferable to having one law for interstate surface waters and another for groundwater. Using equitable apportionment as the integrating principle has the advantage of allowing states to plan, conserve and manage waters over time while preventing any one state or region from taking more than an equitable share. (Michael-PTT)
W87-02290

STATE AS A PARTICIPANT IN WATER MARKETS: APPROPRIATE ROLES FOR CONGRESS AND THE COURTS,
New Mexico Univ., Albuquerque. School of Law.
C. T. DuMars.
Water Resources Research WRERAO, Vol. 21, No. 11, p 1771-1775, November 1985. 14 ref.

Descriptors: *Water rights, *Judicial decisions, *State jurisdiction, Water supply, Water law, Supreme Court, Congress, Federal jurisdiction, Water policy.

A recent Supreme Court ruling that water is a commodity rejected the assumption that states automatically own the water resources within their boundaries. The possibility and impact of state participation in water markets is discussed in the context of federal-state relations. It is recommended that future Supreme Court decisions affirm state ownership of water resources and protect states from congressional efforts to preclude such ownership. (Michael-PTT)
W87-02291

CURRENT ISSUES IN THE QUANTIFICATION OF FEDERAL RESERVED WATER RIGHTS,
Wyoming Univ., Laramie. Dept. of Economics.
D. S. Brookshire, G. L. Watts, and J. L. Merrill.
Water Resources Research WRERAO, Vol. 21, No. 11, p 1777-1784, November 1985. 43 ref.

Descriptors: *Water rights, *Federal jurisdiction, Judicial decisions, Water policy, Water law, Water supply, Indian lands, Irrigation water.

Federal reserved water rights are reviewed from judicial, institutional and economic perspectives. The implications of using the practicably irrigable acreage standard to quantify Indian reserved water rights is discussed. Current trends in and alternative approaches to quantifying these water rights are also examined. (Michael-PTT)
W87-02292

NATIVE AMERICAN VIEW OF WESTERN WATER DEVELOPMENT,
American Indian Law Center, Inc., Albuquerque, NM.
S. Deloria.
Water Resources Research WRERAO, Vol. 21, No. 11, p 1785-1786, November 1985.

Descriptors: *Water policy, *Indian water rights, *Indian lands, Water rights, Water resources development.

Western water resources development and water use policy issues are examined from the perspective of American Indian water rights. Many of the legal battles involve the definition of the scope of the rights: their priority dates, the measure of the rights, and the uses to which they can be put. This is vitally important to the American legal system. Conflicts of pollitical, economic, and social interest should be managed in a system that ensures a regularity of process and fairness to the Indians. This is a management problem. There always will be competing interests affecting the federal process. The goal should be to manage those interests fairly by removing them from a process where conflicts are resolved in internal meetings to one where everyone concedes the existence of a conflict which is then managed through an open procedure. (Michael-PTT)
W87-02293

6F. Nonstructural Alternatives

THEORETICAL FRAMEWORK OF FLOOD INDUCED CHANGES IN URBAN LAND VALUES,
Iowa Univ., Iowa City. Dept. of Geography.
For primary bibliographic entry see Field 6C.
W87-01889

LOCALIZED CATASTROPHIC DISRUPTION OF THE GASCONADE RIVER FLOOD PLAIN DURING THE DECEMBER 1982 FLOOD, SOUTHEAST MISSOURI,
Southern Illinois Univ. at Carbondale. Dept. of Geology.
For primary bibliographic entry see Field 2E.
W87-02368

CRITICAL ANALYSIS OF RESIDENTIAL FLOOD DAMAGE ESTIMATION CURVES,
Waterloo Univ. (Ontario). Dept. of Civil Engineering.
E. McBean, M. Fortin, and J. Gorrie.
Canadian Journal of Civil Engineering CJCEB8, Vol. 13, No. 1, p 86-94, February 1986. 6 fig, 3 tab, 12 ref.

Descriptors: *Critical analysis, *Flood damage, *Estimating, Cost analysis, Consumer price index, Mathematical analysis, Residential damage, Literature reviews.

A critical review of the problems encountered in attempting to quantify flood damage is used to demonstrate inconsistencies, omissions, and variabilities among previous studies and procedures. The complications present in any attempt to quantify flood damages are considerable. Problems such as the inconsistency in the types of damages recorded, and how the damage information is expressed, introduce complicating aspects for the quantification. An improved degree of commonality in collection and presentation of findings from studies would represent an important step in improving flood damage estimation. The most satisfactory of the studies analyzed were obtained where carefully developed synthetic stage-damage data are adjusted or 'calibrated' using observed flood damage data. A reasonable procedure for updating residential depth-damage data from previous studies, is shown to involve use of the all-items consumer price index. Recommended strategies for flood damage estimation involve calibration of synthetic stage-damage data to observed flood damage data. (Lantz-PTT)
W87-02376

6G. Ecologic Impact Of Water Development

PREDICTING IMPACTS FROM WATER CONSERVATION AND ENERGY DEVELOPMENT ON THE SALTON SEA, CALIFORNIA,
California Univ., Los Angeles. Office of Environmental Science and Engineering.
C. R. Kratzer, W. Dritschilo, L. J. Hannah, and M. A. Broutman.
Water Resources Bulletin WARBAQ, Vol. 21, No. 4, p 565-572, August 1985. 5 fig, 1 tab, 12 ref. Southern California Edison Contract C0991901.

Descriptors: *Environmental impact, *Water quality standards, *Salinity, *Conservation, Geothermal energy, Solar ponds, Salton Sea, Agricultural water conservation.

An input-output model was developed to predict changes in Salton Sea salinity and water level until the year 2000 due to proposed water conservation efforts and geothermal and solar pond energy developments. The model SALINP provided good agreement with the observed salinities for 1960-80. While SALINP was not overly sensitive to one-year changes in any of the major inputs, a change in the historical means of the Imperial Valley runoff and evaporative loss inputs produced a significant effect on future predictions. The proposed water conservation measures caused the predicted Salton Sea salinity for 2000 to greatly exceed 40,000 ppm, the level at which adverse effects to wildlife are believed to occur. The possible geothermal development also produced predicted salinities considerably above 40,000 ppm. The salinity predictions for solar ponds by themselves and in conjunction with geothermal development were below 45,000 ppm for 2000. The solar pond and geothermal combination also resulted in a predicted lowering of the 'natural' water level by 5 to 7 feet by 2000. Using the salinity and water level predictions of the SALINP model and the critical ecosystem salinity level of 40,000 ppm, the following conclusions are made with respect to the impacts of water conservation and energy development on the Salton Sea: (1) The water conservation measures could not be realized without endangering the health of the Sea's ecosystem. (2) None of the geothermal scenarios could be implemented by themselves without adversely impacting the Sea's ecosystem. (3) The development of solar ponds by themselves or in conjunction with geothermal development could reverse the trend of increasing salinity in the Sea, and possibly salvage the existing ecosystem. (4) The management options in (3) would also lower the 'natural' water level by 5 to 7 feet by 2000, and would reduce the Sea's 'natural' surface area by 7 to 15 percent. (Peters-PTT)
W87-01897

DESIGN AND IMPACT ANALYSIS FOR DIVERSION AT COAL CREEK MINE,
Utah Center for Water Resources Research, Logan.
For primary bibliographic entry see Field 4A.
W87-01934

ENVIRONMENTAL IMPACT ASSESSMENT: 'PSEUDOREPLICATION' IN TIME,
California Univ., Santa Barbara. Dept. of Biological Sciences.
A. Stewart-Oaten, and W. W. Murdoch.
Ecology ECOLAR, Vol. 67, No. 4, p 929-940, August 1986. 5 fig, 54 ref. NSF Grant BSR 83-15235.

Descriptors: *Environmental impact statement, *Statistical analysis, *Sampling, Probabilistic process, Populations, Biological samples, Discharge measurement, Environmental effects.

A sampling technique designed to address problems of correct identification of the statistical parameter of interest in environmental impact assessment is presented. Using the startup of a power plant as an example, detection of the effects of effluent discharge can be achieved by testing whether the difference between the abundance of biological populations at a control site and an impact site changes with the onset of the discharge. This process requires sampling at both the control and impact sites that can be replicated in time and undertaken both before and after discharge begins. A control site should be selected that is sufficiently far from the impact site to prevent discharge influence, but close enough that it is influenced by the same range of phenomena, such as weather. This approach is inappropriate where local events cause control and impact sites to have different long term trends in abundance, but such situations can be statisically detected. Assumptions regarding additivity and independence of this assessment process are also discussed. (Michael-PTT)
W87-02104

EVOLVING FRAMEWORK FOR ENVIRONMENTAL IMPACT ANALYSIS. I. METHODS,
Maritime Testing (1985) Ltd., Dartmouth (Nova

Scotia). Environmental Div.
S. A. M. Conover, K. W. Strong, T. E. Hickey, and F. Sander.
Journal of Environmental Management JEVMA, Vol. 21, No. 4, p 343-358, December 1985. 4 fig, 2 tab, 14 ref.

Descriptors: *Environmental impact statement, *Models, Environmental policy, Environmental effects, Project planning, Decision making, Policy making, Population, Prediction, Ecosystems.

A framework for biophysical environmental impact analysis is presented. Definition of spatial, temporal and population boundaries is required and potential impacts are evaluated using a predetermined set of ecologically based impact definitions. The framework consists of project and environmental conditions descriptions, investigation of all project and the relevant environmental attributes, impact evaluation, identification of mitigation measures and evaluation of residual impacts. This framework is applicable to terrestrial and aquatic environments and can address concerns at the individual, population, species and ecosystems levels. (See also W87-02114) (Author's abstract)
W87-02113

EVOLVING FRAMEWORK FOR ENVIRONMENTAL IMPACT ANALYSIS: II. APPLICATIONS,
Maritime Testing (1985) Ltd., Dartmouth (Nova Scotia). Environmental Div.
S. A. M. Conover, K. W. Strong, T. E. Hickey, and F. Sander.
Journal of Environmental Management JEVMA, Vol. 21, No. 4, p 359-374, December 1985. 3 fig, 16 ref.

Descriptors: *Environmental impact statement, *Models, Environmental policy, Environmental effects, Project planning, Decision making, Policy making, Pipelines, Aluminum smelters, Oil spills, Offshore platforms, Fate of pollutants, Prediction, Canada.

A framework for environmental impact analysis was applied to four potential impact examples to demonstrate the applicability of the approach to all environmental situations. Analysis examples are included for direct physical disturbance (pipelines), routine discharges (aluminum smelters), accidental releases (oil spills) and the cumulative effects of routine discharges (offshore drilling). Each problem is analyzed by describing project and environmental conditions, identifying project-environment interactions, investigating project and environmental characteristics, evaluating immediate impacts, identifying mitigation measures and evaluating residual impacts. This framework can be used to clarify when and where more sophisticated means of analysis should be applied. (See also W87-02113) (Michael-PTT)
W87-02114

CHANGES IN LIGHT ATTENUATION DURING FILLING, STABILIZATION AND OPERATION OF A RESERVOIR,
Upstate Freshwater Inst., Inc., Syracuse, NY.
For primary bibliographic entry see Field 2H.
W87-02196

ROLE AND IMPORTANCE OF ECOSYSTEMS IN THE BIOSPHERE,
University of Agriculture, Godollo (Hungary). Dept. of Botany and Plant Physiology.
For primary bibliographic entry see Field 2K.
W87-02555

7. RESOURCES DATA

7A. Network Design

SPACE-TIME CORRELATION AND ITS EFFECTS ON METHODS FOR DETECTING AQUATIC ECOLOGICAL CHANGE,
Washington Univ., Seattle. Center for Quantitative Science in Forestry, Fisheries, and Wildlife.
S. P. Millard, J. R. Yearsley, and D. P. Lettenmaier.
Canadian Journal of Fisheries and Aquatic Sciences CJFSBX, Vol. 42, No. 8, p 1391-1400, August 1985. 9 fig, 8 tab, 27 ref. Electrical Power Research Institute Project RP 1729-1.

Descriptors: *Space-time correlation, *Analysis of variance, *Monitoring, *Ecological change, *Monte Carlo simulations, Mathematical models, Sampling design.

The analysis of variance (ANOVA) is used commonly to analyze observations collected from aquatic monitoring programs designed to detect ecological change. ANOVA assumes that the deviations of observations from their true means are uncorrelated in space and time. Aquatic monitoring data often violate this assumption. The results of Monte Carlo simulations using simulated data generated from both statistically and mechanistically based models show that the presence of either spatially or temporally correlated errors can significantly affect the outcome of ANOVA tests. In practice, spatial correlation is more likely to be a problem than is temporal correlation, given typical monitoring frequencies. The effects of spatial correlation can be minimized through judicioius use of control station pairing in the monitoring design. However, when insufficient flexibility exists in the monitoring design, alternate models, such as multivariate time series analysis or multivariate analysis of variance, must be used in place of ANOVA. (Author's abstract)
W87-01802

VARIABILITY OF DENSITY ESTIMATES AND THE OPTIMIZATION OF SAMPLING PROGRAMS FOR STREAM BENTHOS,
McGill Univ., Montreal (Quebec). Dept. of Biology.
A. Morin.
Canadian Journal of Fisheries and Aquatic Sciences CJFSBX, Vol. 42, No. 9, p 1530-1534, September 1985. 5 fig, 1 tab, 30 ref.

Descriptors: *Benthos, *Streams, *Data transformations, *Statistical analysis, *Samplers, *Mean density, *Feeding behavior, *Artificial substrates, *Replication, Sampling variance, Precision, Cost analysis, Management planning.

Several sets of published data were reanalyzed to examine the effect of mean density, size and type of sampler, and functional group (predators, shredders, scrapers, collectors, filter-feeders, and unknown) of the collected organisms on the variance of estimates of stream benthos density. Because of the curvilinear relationship between the logarithm of the variance and the logarithm of the mean density, the author suggests that none of the commonly-used transformations (square root, fourth root, or logarithmic) will stablize the variance at all the densities encountered. Information about sampler size (Q, sq m) further improves the prediction of the logarithm of the sampling variance, which increases with an increase in mean density and decreases with an increase in the size of the sampler. On average, density estimates obtained with artificial substates were as variable as those with natural substrates, although some artificial substrates (baskets of rocks) yield less variable density estimates than average. The number of replicates necessary to obtain a given precision decreases with increasing mean density and sampler size, whereas the total area sampled increases with sampler size. Although the use of small samplers reduces the cost of estimates of density, the sampler size that minimizes the sum of sampling and processing effort can depend on the mean density. (Author's abstract)
W87-01807

ESTIMATING THE STANDING BIOMASS OF AQUATIC MACROPHYTES,
Montreal Univ. (Quebec). Dept. of Biological Sciences.
For primary bibliographic entry see Field 2H.
W87-01810

ASSESSMENT OF REMOTE SENSING INPUT TO HYDROLOGIC MODELS,
Agricultural Research Service, Beltsville, MD. Hydrology Lab.
For primary bibliographic entry see Field 2A.
W87-01914

JUSTIFICATION FOR A REDUCTION IN THE CREST-STAGE GAGE PROGRAM IN LOUISIANA,
Geological Survey, Lakewood, CO. Water Resources Div.
R. A. Herbert, D. D. Carlson, and G. J. Wiche.
Water Resources Bulletin WARBAQ, Vol. 21, No. 6, p 953-965, December 1985. 9 fig, 7 tab, 8 ref.

Descriptors: *Flood frequency, *Network design, *Crest gages, *Flood peak, Louisiana, Drainage areas, Urban areas, Watershed characteristics, Monitoring, *Network analysis.

The crest-stage gage program in Louisiana was evaluated to determine if the data were adequate for use in developing regional flood-frequency equations and to determine if any crest-stage gage stations could be discontinued. The crest-stage gage network in Louisiana in 1983 consisted of 96 crest-stage gage stations. Drainage areas range from 0.13 to 884 sq mi. Approximately 12 percent of the stations have drainage areas less than 10 sq mi, 58 percent are 10 to 50 sq mi, and about 30 percent are greater than 50 sq mi. An abundance of data at many crest-stage gage stations and a lack of data for urban areas and flat-slope areas indicated a need for a shift in the number, type, and locations of gages. Correlations and comparisons of annual peak discharges and watershed characteristics of 96 existing stations resulted in the elimination of 72 stations and the addition of one new station, reducing the total network to 25 stations that could be used for future flood-frequency analyses. The adequacy of the reduced network for development and verification of regional flood-frequency equations was tested by comparing a set of regional flood-frequency equations developed using data from the full network with a set developed using data from the reduced network. The results indicate that the crest-stage gage network can be reduced to 25 stations and still provide adequate information for future flood-frequency anaylses. (Peters-PTT)
W87-01930

ENVIRONMENTAL IMPACT ASSESSMENT: 'PSEUDOREPLICATION' IN TIME,
California Univ., Santa Barbara. Dept. of Biological Sciences.
For primary bibliographic entry see Field 6G.
W87-02104

ATMOSPHERIC DEPOSITION TO REMOTE RECEPTORS: I. PRECIPITATION QUANTITIES FRO THE ILWAS-NETWORK,
Rensselaer Polytechnic Inst., Troy, NY. Dept. of Chemical and Environmental Engineering.
For primary bibliographic entry see Field 2B.
W87-02197

ATMOSPHERIC DEPOSITION TO REMOTE RECEPTORS: II. TEMPORAL AND SPATIAL VARIATION OF INORGANIC ION SPECIES IN PRECIPITATION OVER THE ILWAS-NETWORK,
Rensselaer Polytechnic Inst., Troy, NY. Dept. of Chemical and Environmental Engineering.
For primary bibliographic entry see Field 5B.
W87-02198

HYDROELECTRIC RESOURCE STUDIES IN TOGO AND BENIN,
H. R. Tomson.
Proceedings of Institutional Civil Engineers PCIEAT, Vol. 78, No. 1, p 1403-1420, December 1985. 7 fig, 3 tab.

Descriptors: *Benin, *Togo, *Hydroelectric power, *Water resources development, Site selec-

tion, Reservoir sites, On-site investigations, Planning, Geography, Economic aspects, Economic feasibility.

Classification of a large number of potential hydroelectric sites was required for preparation of an inventory of hydroelectric resources for the countries of Toga and Benin. The studies performed, the methods used for initial classification of 44 sites and the subsequent pre-feasibility studies of seven sites selected for hydroelectric development are described. Classification methods used were chosen with regard to the appropriate level of study and time and budget constraints. Studies of existing maps were combined with ground and aerial reconnaissance of remote areas. A technique was developed which permitted rapid assessment of many sites using a relatively small project team. The results of pre-feasibility studies have confirmed the ranking of the most economically beneficial projects. (Michael-PTT)
W87-02268

BRIDGING THE GAP BETWEEN FLOOD RESEARCH AND DESIGN PRACTICE,
New South Wales Univ., Kensington (Australia). School of Civil Engineering.
D. H. Pilgrim.
Water Resources Research WRERAO, Vol. 22, No. 9, p 165S-176S, August 1986. 1 tab, 55 ref.

Descriptors: *Research needs, *Flood forecasting, *Design criteria, *Watersheds, Rural areas, Urban areas, Geomorphology, Management planning, Flood profiles.

It is important that scientific research on physical systems and applied research on the development of design procedures should both contribute to narrowing the gap between research and practice in flood estimation. The contribution of applied research would be aided by better information on current needs and practice, wider recognition of the economic importance of small rural and urban watersheds and of problems with geomorphological measures used in design relationships, and the use of identical procedures and measures in derivation and application of methods. For scientific research, some aspects of the use of the computer have been counterproductive. Several problems related to both types of research also contribute to the gap with practice. These concern current trends in data storage, inadequate information on accuracy of data, regional differences in flood characteristics, and various common assumptions that need to be challenged and evaluated. Inadequate attention has been given by researchers to several problems of considerable importance to practice. (Author's abstract)
W87-02325

DILETTANTISM IN HYDROLOGY: TRANSITION OR DESTINY,
National Hydrology Research Inst., Ottawa (Ontario).
For primary bibliographic entry see Field 6B.
W87-02326

SAMPLING FRAMEWORK FOR OBTAINING A STATISTICALLY HOMOGENEOUS POPULATION OF DRAINAGE BASINS,
Ondo State Univ., Ado-Ekiti (Nigeria). Dept. of Geography.
F. S. Ebisemiju.
Water Resources Research WRERAO, Vol. 21, No. 10, p 1567-1568, October 1985. 2 fig, 1 tab, 8 ref.

Descriptors: *Catchment areas, *Network design, *Statistical analysis, *Homogeneity, *Drainage, *Networks, Hydrologic systems, Geomorphology, Water sampling.

Spatial scale dependencies of hydrological and geomorphological processes, patterns, and interrelationships signpost the need to ensure that geomorphic units defined at any scale are statistically homogeneous with regard to size magnitude. Statistical analyses of the areas of drainage basins sampled by network order, magnitude, and diameter reveal that network order is too coarse a sampling framework for establishing spatial scale differences. Although both the network diameter and magnitude criteria generate statistically homogeneous populations of drainage basins, the former provides a more realistic sampling framework, because within a homogeneous region, sampling by the network magnitude criterion fails to generate enough sample replicates of the higher-magnitude networks. (Author's abstract)
W87-02386

GROUND WATER FLOW IN LIMESTONE TERRANES: STRATEGY RATIONALE AND PROCEDURE FOR RELIABLE, EFFICIENT MONITORING OF GROUND WATER QUALITY IN KARST AREAS,
National Park Service, Mammoth Cave, KY.
For primary bibliographic entry see Field 2F.
W87-02511

DEVELOPMENT OF A GROUND WATER MODEL UTILIZING THE INSTALLATION AND TESTING OF A VARIABLE DEPTH CLUSTER MONITORING WELL NETWORK,
Hess (R.K.R.) Associates, Stroudsburg, PA.
W. L. Hopkins, P. A. DeBarry, and R. W. Knight.
IN: Proceedings of the Fifth National Symposium and Exposition on Aquifer Restoration and Ground Water Monitoring, May 21-24, 1985, The Fawcett Center, Columbus, Ohio. 1985. p 357-371, 5 fig, 13 ref.

Descriptors: *Path of pollutants, *Underwground waste/disposal, *Groundwater pollution, *Monitoring wells, *Networks, Groundwater movement, Piezometry, Hydraulic gradient, Groundwater quality, Hydraulic conductivity, Costs, Model studies, Simulation analysis.

The fate of nitrate-nitrogen transport in the groundwater underlying subsurface sewage disposal systems is not well known or documented. For large proposed disposal systems in Pennsylvania, a hydrogeologic study must be conducted to assure that the groundwater will meet EPA Drinking Water Standards at the downgradient property line. A study of this sort often entails the installation of (a) piezometers to obtain groundwater flow direction and hydraulic gradient and (b) a monitoring well network to obtain continued records of groundwater quality. a low cost method was devised to install four, six inch diameter wells surrounding a 17,720 gpd subsurface disposal system used to monitor three groundwater zones in each borehole, obtain the hydraulic conductivity of each depth measured, and establish the hydraulic gradient. Costs were minimized by clustering three wells in a single borehole utilizing bentonite seals, using a standard hydraulic rotary drilling rig and obtaining the hydraulic conductivity by head recovery on a single well versus using a tracer test on two adjacent holes. Utilizing the data obtained from the wells, a model was developed to estimate the contamination plume depth of penetration and horizontal flow direction and displacement. The model simulates effluent plume dilution due to groundwater recharge and effluent mixing. The results of the analysis predicted that the proposed subsurface disposal system would not raise nitrate-nitrogen concentrations above drinking water standards at the property line downgradient of the system. (See also W87-02497) (Author's abstract)
W87-02518

COMBINED EM RESISTIVITY AND FLUOROMETRY WITH DIRECT GROUNDWATER FLOW MEASUREMENT FOR LOCAL CHARACTERIZATION OF LANDFILL PLUMES,
K-V Associates, Inc., Falmouth, MA.
For primary bibliographic entry see Field 5B.
W87-02519

DEVELOPMENT OF AN ADEQUATE RCRA GROUND WATER MONITORING SYSTEM IN FRACTURED SEDIMENTARY BEDROCK: A CASE STUDY,
West Virginia Dept. of Natural Resources, Charleston. Div. of Water Resources.
For primary bibliographic entry see Field 5G.
W87-02542

7B. Data Acquisition

HIGH-DENSITY CULTURE OF MEIOBENTHIC HARPACTICOID COPEPODS WITHIN A MUDDY SEDIMENT SUBSTRATE,
Louisiana State Univ., Baton Rouge. Dept. of Zoology and Physiology.
For primary bibliographic entry see Field 2H.
W87-01820

MAPPING PALEOCHANNELS IN FLUVIAL DEPOSITS THROUGH THE APPLICATION OF GEOTECHNICAL STRATIGRAPHY,
For primary bibliographic entry see Field 2E.
W87-01841

ORIENTATION OF CLAMSHELLS AS A VELOCITY INDICATOR IN A CANAL,
Water and Power Resources Service, Sacramento, CA. Mid-Pacific Region.
For primary bibliographic entry see Field 2E.
W87-01842

SIMULTANEOUS MULTI-ELEMENT DETERMINATION OF TRACE METALS IN SEA WATER BY INDUCTIVELY-COUPLED PLASMA ATOMIC EMISSION SPECTROMETRY AFTER COPRECIPITATION WITH GALLUM,
Tokyo Univ. (Japan). Dept. of Chemistry.
For primary bibliographic entry see Field 5A.
W87-01863

HYDROLYTIC POTENTIOMETRIC TITRATION OF SULFATE WITH APPLICATION IN THE ANALYSIS OF WATERS,
Maribor Univ. (Yugoslavia). Dept. of Chemical Engineering.
For primary bibliographic entry see Field 5A.
W87-01864

AUTOMATED SYSTEM FOR THE DETERMINATION OF FLUORIDE,
La Trobe Univ., Bundoora (Australia). Analytical Chemistry Labs.
For primary bibliographic entry see Field 5A.
W87-01865

USE OF GEOPHYSICAL LOGS FOR DETERMINING FORMATION WATER QUALITY,
Woodward-Clyde Consultants, Tallahassee, FL.
For primary bibliographic entry see Field 5A.
W87-01870

APPLICATION OF CONTINUOUS SEISMIC REFLECTION METHODS TO HYDROLOGIC STUDIES,
Geological Survey, Hartford, CT. Water Resources Div.
For primary bibliographic entry see Field 2F.
W87-01872

ASSESSMENT OF REMOTE SENSING INPUT TO HYDROLOGIC MODELS,
Agricultural Research Service, Beltsville, MD. Hydrology Lab.
For primary bibliographic entry see Field 2A.
W87-01914

AIRBORNE THERMAL MAPPING OF A FLOW-THROUGH LAKE IN THE NEBRASKA SANDHILLS,
Nebraska Univ., Lincoln. Conservation and Survey Div.
For primary bibliographic entry see Field 2H.
W87-01933

BIOMASS ASSESSMENT OF ESTUARINE MACROPHYTOBENTHOS USING AERIAL PHOTOGRAPHY,
Rijkswaterstaat, The Hague (Netherlands).
For primary bibliographic entry see Field 2L.
W87-01940

MODIFIED, TRAPEZOIDAL VENTURI CHANNEL,
Ecole Polytechnique Federale de Lausanne (Switzerland). Dept. de Genie Civil.
For primary bibliographic entry see Field 8B.
W87-01952

SATELLITE PASSIVE 37-GHZ SCATTERING-BASED METHOD FOR MEASURING OCEANIC RAIN RATES,
National Aeronautics and Space Administration, Huntsville, AL. George C. Marshall Space Flight Center.
R. W. Spencer.
Journal of Climate and Applied Meteorology JCAMEJ, Vol. 25, No. 6, p 754-766, June 1986. 11 fig, 17 ref. NASA Contract NAS8-34767.

Descriptors: *Satellite technology, *Rainfall rate, *Oceanic rain, Radar, Rainstorms, Remote sensing.

A scattering-based method for quantitatively measuring rainfall over the ocean is developed using Nimbus-7 Scanning Multichannel Microwave Radiometer (SMMR) 37-GHz observations. This technique takes the observed scattering effects of precipitation on 37-GHz brightness temperatures and applies it to the oceanic environment. It requires an estimate of the effective radiating temperature of the cloudy portion of the atmosphere, and a brightness temperature measurement of the cloud-free ocean surface. These two measurements bound all possible combinations of clear and cloudy conditions within a footprint in terms of bipolarized brightness temperatures. Because the technique involves a linear transformation between dual polarized brightness temperature and rain rate, there are no nonlinear footprint filling effects and a unique footprint-averaged rain rate results. These SMMR-derived rain rates for five cases of convection over the Gulf of Mexico are shown to be closely related to simultaneously derived radar rain rates, having a correlation of 0.90. The technique is also applied to a massive squall line over the Gulf of Mexico; the resulting rain rate distribution reflects features found in cloud top heights and texture inferred from GOES infrared and visible imagery. (Author's abstract)
W87-01960

MULTIPLE REMOTE SENSOR OBSERVATIONS OF SUPERCOOLED LIQUID WATER IN A WINTER STORM AT BEAVER, UTAH,
Utah Univ., Salt Lake City. Dept. of Meteorology.
For primary bibliographic entry see Field 2B.
W87-01961

SIMULTANEOUS DETERMINATION OF MOISTURE, ORGANIC CARBON, AND TOTAL NITROGEN BY NEAR INFRARED REFLECTANCE SPECTROPHOTOMETRY,
Queensland Dept. of Primary Industries, Toowoomba (Australia). Wheat Research Inst.
R. C. Dalal, and R. J. Henry.
Soil Science Society of America Journal SSSJD4, Vol. 50, No. 1, p 120-123, January-February 1986. 5 fig, 3 tab, 10 ref.

Descriptors: *Near-infrared diffuse reflectance spectrometry, *Soil tests, *Infrared spectrophotometry, *Spectrophotometry, *Organic carbon, *Soil moisture, *Soil nitrogen, Calibration equations, Standard errors, Prediction, Organic matter, Soil chemistry.

Near infrared diffuse reflectance spectrometry, within the wavelength range 1,100 to 2,500 nanometer (nm), was investigated for use in the simultaneous prediction of the moisture, organic C, and total N contents of air-dried soils. An InfraAlyzer 500 C scanning spectrophotometer was used to obtain near infrared reflectance of soils at 2-nm intervals. Calibration equations for each of the soil constituents studied were based upon selection of the best combination of three wavelengths in a multiple regression analysis. The wavelengths selected for moisture, organic C, and total N were, respectively, 1,926, 1,954, and 2,150 nm; 1,744, 1,870, and 2,052 nm; and 1,702, 1,870, and 2,052 nm. The standard errors of prediction for finely ground samples (<0.25 mm) from the top layers (0-0.1, 0.1-0.2, 0.2-0.3, and 0.3-0.6 m) were 0.58, 0.16, and 0.014% for moisture, organic C, and total N, respectively. The standard errors of prediction were much larger for coarsely ground soils, for soils containing <0.3% organic C and <0.3% total N, and for those with a wide range in colors. Within a narrow range of soil color and at moderate amounts of organic matter (0.3-2.5% C), the near infrared reflectance method provides a rapid, nondestructive, and simultaneous measurement of moisture, organic C, and total N in soils. (Author's abstract)
W87-01992

FIELD MEASUREMENT OF DENITRIFICATION IN IRRIGATED SOILS,
Brigham Young Univ., Provo, UT. Dept. of Agronomy and Horticulture.
For primary bibliographic entry see Field 2G.
W87-02001

ESTIMATING AVAILABLE WATER-HOLDING CAPACITY OF WESTERN NIGERIAN SOILS FROM SOIL TEXTURE AND BULK DENSITY, USING CORE AND SIEVED SAMPLES,
Ife Univ. (Nigeria).
For primary bibliographic entry see Field 2G.
W87-02003

PREDICTION OF HYDRAULIC CONDUCTIVITY FROM SOIL WATER RETENTION DATA,
Commonwealth Scientific and Industrial Research Organization, Canberra (Australia). Div. of Forest Research.
For primary bibliographic entry see Field 2G.
W87-02013

APPLICATON OF ATMOSPHERIC NEUTRONS TO SOIL MOISTURE MEASUREMENT,
Yamanashi Medical Coll., (Japan). Dept. of Physics.
M. Kodama, S. Kudo, and T. Kosuge.
Soil Science SOSCAK, Vol. 140, No. 4, p 237-242, October 1985. 7 fig, 1 tab, 8 ref, append.

Descriptors: *Newtron moisture meters, *Soil moisture meters, *Atmospheric neutrons, *Soil water, *Regression equations, Statistics, Soil physical properties, Measuring instruments.

Using polyethylene-moderated BF3 neutron counters at several underground depths, time variations in neutron fluxes were measured to examine their quantitative responses to soil moisture changes. Close correlations between neutron fluxes and soil moisture changes are used to show that the fluxes of the underground neutrons with energies from the cadmium threshold of 0.025 eV to about 1,000,000 eV, measured at a depth of 20 cm, are affected most sensitively by the moisture content of the soil at the same depth. Their fractional change is represented by a regression coefficient of 1% per unit percent of soil moisture change for a range from 33% (about 2.8 pF) to 52% (about 1.9 pF) at the 20 cm depth. This neutron technique promises to be a simple and reliable measurement that depends on the counting statistics of neutrons. (Author's abstract)
W87-02014

IN SITU MEASUREMENT OF FIELD-SATURATED HYDRAULIC CONDUCTIVITY, SORPTIVITY, AND THE ALPHA-PARAMETER USING THE GUELPH PERMEAMETER,
Guelph Univ. (Ontario). Dept. of Land Resource Science.
W. D. Reynolds, and D. E. Elrick.
Soil Science SOSCAK, Vol. 140, No. 4, p 292-302, October 1985. 3 fig, 5 tab, 16 ref.

Descriptors: *Permeameters, *Hydraulic conductivity, *Soil moisture meters, *Sorption, *Alpha-parameter, *Guelph permeameter method, *Permeability coefficient, Richards analyses, Laplace analyses, *Capillarity, *Infiltration, Measuring well radius, Equations, Soil cores, Pressure head, Soil types.

The Guelph permeameter method was used in 0.02-m- and 0.03-m-radius wells to measure in situ the field saturated hydraulic conductivity (K sub fs) and matrix flux potential (phi sub m) of a heterogeneous, anisotropic, structured loam soil. The K sub fs estimates, obtained using both Richards (GP-R) and Laplace (GP-L) analyses, were compared with saturated hydraulic conductivity measurements (K sub s) obtained using vertically and horizontally oriented, 'undisturbed' soil cores. The phi sub m values, obtained using both GP-R and the Gardner (GP-G) analyses, were used in estimating soil sorptivity (S) and the alpha-parameter of the exponential hydraulic conductivity-pressure head relationship for infiltration. The K sub fs values effectively averaged the vertical and horizontal K sub s values. In accordance with the theoretical prediction, the GP-L calculation of K sub fs, which neglects capillarity, significantly overestimated the GP-R calculation, which accounts for capillarity. The mean S estimates obtained are plausible for the soil type and conditions, but the alpha values are high relative to some published values. K sub fs and Phi sub m estimates from the GP-R analysis are considered valid and accurate if they are both positive and both lower than their corresponding GP-L and GP-G estimates. (Rochester-PTT)
W87-02016

STATIC AND DYNAMIC THREE-DIMENSIONAL STUDIES OF WATER IN SOIL USING COMPUTED TOMOGRAPHIC SCANNING,
EMBRAPA-UEPAE, Sao Carlos (Brazil).
S. Crestana, S. Mascarenhas, and R. S. Pozzi-Mucelli.
Soil Science SOSCAK, Vol. 140, No. 5, p 326-332, November 1985. 5 fig, 11 ref.

Descriptors: *Computed tomography, *Soil water, *Soil texture, *Soil horizons, *Sand, *Loam, *Measuring instruments, Brazil, Italy, Linear equation, Hounsfield units.

X-ray transmission, computed tomography (CT) scanning was employed to measure soil water characteristics of soils of different textures: the Ap horizon of a Trieste, Italy, sandy soil and a Barretos, Brazil, fine sandy loamy soil. It is shown that CT can be used to measure the water content of soil and to follow dynamically the motion of water in soil in three dimensions. Furthermore, inhomogeneities of water content and motion in soil can be observed with this technique. Using a third-generation CT scanner, several different techniques can be applied, including differential, real-time, and spatial distribution scanning modes. A linear dependence was demonstrated between the Hounsfield units used in CT and water content. (Rochester-PTT)
W87-02017

THEORY, CONSTRUCTION, AND OPERATION OF SIMPLE TENSIOMETERS,
D. I. Stannard.
Ground Water Monitoring Review, Vol. 6, No. 3, p 70-78, Summer 1986. 9 fig, 15 ref.

Descriptors: *Tensiometers, *Manufacture, *Aeration zone, *Matric potential, *Operation, *Installation, *Hazardous waste disposal, Field studies, Soil moisture meters, Cost analysis, Measuring instruments.

The theory of construction and installation, operation and measurement, and maintenance of the mercury tensiometer are described. Although the tensiometer often has been ignored in unsaturated zone investigations, hazardous waste disposal studies that require values of unsaturated zone matric

potentials will expand tensiometer use. The essential elements of a tensiometer are a porous cup connected with tubing to a vacuum gauge; all are filled with water. When the porous cup is buried in unsaturated soil, the soil draws water through the cup wall until the water tension inside the cup equals the surrounding soil water tension. The tension is transmitted through the water-filled tube to an accessible vacuum gauge (manometer or transducer) and is recorded manually or automatically. The tensiometer presented here is suited to diverse on-site applications; it is constructed of readily available, inexpensive parts and can measure as much as 0.85 bar of tension. A good hydraulic connection between porous cup and soil and meticulous backfill procedures are necessary for accurate measurement of representative matric potentials. (Rochester-PTT)
W87-02058

INEXPENSIVE FLOW-THROUGH CELL AND MEASUREMENT SYSTEM FOR MONITORING SELECTED CHEMICAL PARAMETERS IN GROUND WATER,
Illinois State Water Survey Div., Champaign. Aquatic Chemistry Section.
E. E. Garske, and M. R. Schock.
Ground Water Monitoring Review, Vol. 6, No. 3, p 79-84, Summer 1986. 7 fig, 26 ref.

Descriptors: *Oxidation-reduction potential, *Conductivity, *Hydrogen ion concentration, *Groundwater chemistry, Membrane filter, Measuring instruments, Gran plot titration, Field tests, Alkalinity, Water analysis.

An inexpensive flow-through cell was designed and constructed to enable the accurate measurement of redox potential (Eh), conductivity, and pH from shallow monitoring wells. The cell accepts sample water from inert-gas-operated bladder pumps. The electrodes are monitored by meters mounted in portable, rugged waterproof carrying case. The cell is useful for monitoring the purging of stagnant water from the well prior to sample collection for chemical analysis, as well as to provide pH, Eh, and conductivity data under conditions as close to in situ as presently practical. In conjunction with the development of the flow-through cell and measuring system, a portable field kit was constructed and equipped to determine the alkalinity of the water via modified Gran plot titration, immediately upon sample collection. In addition to the measurement cell system, an in-line membrane filter system was developed that included valves to sequentially switch to different filter units in case of membrane plugging. (Author's abstract)
W87-02059

SULFUR AND CARBON ISOTOPES AS TRACERS OF SALT-MARSH ORGANIC MATTER FLOW,
Marine Biological Lab., Woods Hole, MA. Ecosystems Center.
For primary bibliographic entry see Field 2G.
W87-02099

SCADA SYSTEMS TODAY AND TOMORROW,
Engineering Design Group, Inc., Tulsa, OK.
C. H. Heywood.
WATER Engineering & Management WENMD2, Vol. 133, No. 7, p 18-20, July 1986.

Descriptors: *Water treatment, *SCADA systems, *Computers, *Control systems, *Data acquisition, *Monitoring, Remote sensing, Artificial intelligence, Water management.

The evolution and application of computer-based supervisory control and data acquisition (SCADA) systems for process monitoring and control of water distribution and treatment systems is reviewed. Prospects for future advancements in SCADA systems such as remote maintenance monitoring capabilities and the application of artifical intelligence are also discussed. (Michael-PTT)
W87-02105

COMPUTERIZED GRID PRESSURE CONTROL OF DISTRIBUTION SYSTEM IS SCADA BENCHMARK,
Houston Ground Water Section, TX.
L. M. Bowen, and C. W. Brown.
WATER Engineering & Management, Vol. 133, No. 7, p 21-22, July 1986.

Descriptors: *Computers, *Control systems, *Pressure distribution, Data acquisition, Monitoring, Remote sensing, Metropolitan water management, Houston, Tx.

A project to implement a supervisory control and data acquisition (SCADA) system for grid pressure control of the Houston, Tx. water distribution system is described. When completed, the upgraded control system will feature dual host computers, 'smart' remote terminal units, and 120 sensing points. The SCADA system will provide a tool for real-time monitoring and control of water production and distribution for the next 10 to 15 years. (Michael - PTT)
W87-02106

COMPUTERIZED WATER SYSTEM: FROM PITFALLS TO PERFECTION,
Greeley and Hansen, Chicago, IL.
T. Greif.
Water Engineering and Management WENMD2, Vol. 133, No. 7, p 24-26, July 1986.

Descriptors: *Computers, *Water treatment, *Control systems, *Data a acquisition, *Monitoring, Water supply, Illinois, Pumping plants, Reservoir storage, Metropolitan water management.

A computerized monitoring and control system was developed for the village of Mount Prospect, IL. When its water supply was transitioned from local water to purchased water from the City of Chicago. The computer system provides automatic control of reservoir refilling and high service pumping operations based on two alternate modes of level control. The system is considered an effective water management tool by eliminating manual logging of operational data and automating system responses to demand fluctuations. (Michael-PTT)
W87-02107

CLIMATE PREDICTION IN THE TROPICS,
Wisconsin Univ.-Madison. Dept. of Meteorology.
For primary bibliographic entry see Field 2B.
W87-02109

URBAN HYDROMETEOROLOGY REVIEW,
Illinois State Water Survey Div., Champaign. Climatology and Meteorology Section.
For primary bibliographic entry see Field 2B.
W87-02110

PREPARATION OF UNSMEARED SOIL SURFACES AND AN IMPROVED APPARATUS FOR INFILTRATION MEASUREMENTS,
Sydney Univ. (Australia). Dept. of Soil Science.
For primary bibliographic entry see Field 2G.
W87-02118

FRAZIL MEASURED IN THE LABORATORY AND IN THE FIELD,
National Water Research Inst., Burlington (Ontario). Hyrdraulics Research Div.
G. Tsang.
Nordic Hydrology, Vol. 17, No. 2, p 115-128, 1986. 9 fig, 2 tab, 17 ref.

Descriptors: *Measuring instruments, *Data acquisition, *Frazil ice, Saline water, Ice, Beauharnois Canal, Quebec, Agglomeration.

Using the newly developed frazil instrument, the concentration of frazil in flowing water was measured in the laboratory for fresh water and sea water under various conditions. The concentration of frazil was also measured in the Beauharnois Canal near Montreal. Much information on the agglomeration characteristics of fresh water and sea water frazil was obtained from these laboratory and field experiments, although more work is still needed in adding more knowledge to this frontier of research. The frazil instrument may be used operationally to detect and monitor frazil continuously in industrial installations. Because of the delicate nature of the instrument and the fact that the sensing surfaces of the probes can easily get contaminated by foreign materials in the water, frequent cleansing and maintenance are necessary. One practical way of incorporating the instrument into an industrial warning and monitoring system is to construct a small diameter by-pass which will take water samples continuously at the intake and return them to the penstock at some point downstream. In the middle of this by-pass will be an open well into which the probes can be immersed. Provisions in the well should be made to ensure that no frazil would enter the reference probe. Over the well a small heated hut may be built to keep the instrument from the hostile environment and to facilitate the frequent maintenance and cleansing of the instrument. (Lantz-PTT)
W87-02330

SAMPLING FRAMEWORK FOR OBTAINING A STATISTICALLY HOMOGENEOUS POPULATION OF DRAINAGE BASINS,
Ondo State Univ., Ado-Ekiti (Nigeria). Dept. of Geography.
For primary bibliographic entry see Field 7A.
W87-02386

APPLICATION OF SURFACE GEOPHYSICS TO GROUND WATER MANAGEMENT PLANNING,
Weston (Roy F.), Inc., West Chester, PA.
For primary bibliographic entry see Field 5G.
W87-02453

ELECTRICAL RESISTIVITY/TERRAIN CONDUCTIVITY SURVEYS TO TRACE PROCESS WASTEWATER LEACHATE IN GROUNDWATER FROM A SPRAY IRRIGATION SYSTEM,
Jordan Gorrill Associates, Portland, ME.
R. P. Allen, R. Popma, and P. Doolen.
IN: The Second Annual Eastern Regional Ground Water Conference, July 16-18, 1985, Portland, Maine. 1985. p 243-251, 2 fig, 2 tab.

Descriptors: *Resistivity, *Conductivity, *Leachates, *Groundwater pollution, *Spray irrigation, Path of pollutants, Sludge dewatering, Water pollution sources, Plumes, Water pollution control, Groundwater quality, Sedimentation.

This ground conductivity survey corroborated earlier studies which indicated leachate was entering the groundwater flow regime via discharge pipes from an ash disposal site into an unlined drainage ditch south and southwest of the ash disposal site. Leakage from the surface water discharge pipe from the sedimentation pond was also shown to be contributing to groundwater contamination. In addition, the survey also identified another potential source of groundwater contamination, the sludge dewatering pond. The results from the 20-m coil spacing also indicated that the sludge dewatering pond may be providing a pathway for deeper leachate migration. A comparison of results between the November 1984 and April 1985 surveys, indicated a slight seasonal variation in the intensity of the plume, attributable to leachate discharge in the springs. Little migration of the plume was shown between November 1984 and April 1985 survey. Continued monitoring of ground conductivity along the permanently established survey lines will enable an evaluation of the effectiveness of planned remedial measures on improving groundwater quality downgradient of the site. (See also W87-02437) (Lantz-PTT)
W87-02454

MONITORING PLUME MIGRATION USING GROUND SURFACE CONDUCTIVITY,
Empire-Thomsen, Groton, NY.
For primary bibliographic entry see Field 5B.
W87-02455

CONVENTIONAL AND STATE-OF-THE-ART GEOPHYSICAL TECHNIQUES FOR FRACTURE DETECTION,
Weston Geophysical Corp., Westborough, MA.
J. P. Imse, and E. N. Levine.
IN: The Second Annual Eastern Regional Ground Water Conference, July 16-18, 1985, Portland, Maine. 1985. p 261-276, 10 fig, 1 ref.

Descriptors: *Geophysics, *Geologic fractures, *Cost analysis, Bedrock, Case studies, New York, Massachusetts, Radar, Refractivity, Seismology, Groundwater, Hydraulic conductivity.

Geophysical techniques are routinely utilized and widely recognized as accurate and cost-effective methods to determine depth to rock, identify subsurface materials, and locate contaminants. The location and evaluation of bedrock fractures is a commonly overlooked application for geophysical investigations. Bedrock fractures, particularly zones of fractures, typically result in directional anisotropy of characteristic electrical properties and seismic velocities. Case histories of geophysical investigations in carbonate terrain of northern New York and crystalline bedrock of eastern Massachusetts are discussed to illustrate the utility of geophysical methods for future studies. A conventional suite of geophysical techniques, including ground penetrating radar and seismic refraction, were used in New York. The focus of this paper, bedrock fractures, are shown to be mappable using conventional and state-of-the-art geophysical methods. Conventional techniques such as seismic refraction and ground penetrating radar are ideally suited to mapping bedrock fracture zones. A new technique, wide angle vertical seismic profiling, has been developed to be able to locate, map the lateral extent, and determine the hydraulic conductivity of water bearing features in bedrock. (See also W87-02437) (Lantz-PTT)
W87-02456

CONTINUOUS SEISMIC-REFLECTION PROFILING OF A GLACIAL-DRIFT DEPOSIT ON THE SACO RIVER, MAINE AND NEW HAMPSHIRE,
Geological Survey, Augusta, ME. Water Resources Div.
D. J. Morrissey, F. P. Haeni, and D. H. Tepper.
IN: The Second Annual Eastern Regional Ground Water Conference, July 16-18, 1985, Portland, Maine. 1985. p 277-296, 9 fig, 2 tab, 25 ref.

Descriptors: *Geophysics, *Glacial drift, *Saco River, *Maine, *New Hampshire, Seismology, Aquifers, Test holes, Drilling, Data interpretation, Sand, Sediments, Fryeburg.

Continuous seismic-reflection profiling is an efficient geophysical technique for obtaining geohydrologic information for aquifers that directly underlie surface water. This technique was used to determine the stratigraphy of an unconsolidated aquifer, and depth to bedrock, in the Saco River valley, Maine and New Hampshire. The reflection profiles were also used to select test-drilling locations. Continuous seismic-reflection records were obtained during a 2-day period in June 1984, along a 12-mile reach of the Saco River near Center Conway, New Hampshire and Fryeburg, Maine. A small outboard-powered boat was used to collect data in water depths that ranged from 1.5 to 10 feet. The reflection records were interpreted using velocities determined from seismic-refraction surveys run in the area. Depth to bedrock determined from the reflection records ranged from 3 to 225 feet. The records also indicated that much of the overburden consisted of fine-grained sediments that contained isolated areas of coarse-grained material. Test drilling verified the interpreted depth to bedrock, the existence of predominantly fine-grained sediment, and showed that much of the coarse-material is glacial till. A deposit of well sorted, coarse sand was detected above the till near the populated area of Fryeburg. (See also W87-02437) (Author's abstract)
W87-02457

EVALUATION OF GROUND WATER WELL SUPPLIES IN COASTAL NEW HAMPSHIRE BY UTILIZING SURFACE PIEZOMETRIC INFORMATION,
New Hampshire Univ., Durham.
For primary bibliographic entry see Field 4B.
W87-02460

GROUND WATER MONITORING AT A HAZARDOUS WASTE FACILITY LOCATED OVER FRACTURED VOLCANIC ROCK,
R. S. Farrell.
IN: The Second Annual Eastern Regional Ground Water Conference, July 16-18, 1985, Portland, Maine. 1985. p 435-448, 5 fig.

Descriptors: *Groundwater pollution, *Monitoring, *Hazardous wastes, Volcanoes, Path of pollutants, Aquifers, Test wells, Groundwater movement, Basalt.

An existing hazardous waste facility has applied for permits under 264. The site presents different problems in the characterization of the hydrogeology because of the complications related to fractured rock that underlies the facility. The site is underlain by 180 ft of unconsolidated sediments over fractured basalt. The uppermost aquifer occurs above the contact with the basalt. The site characterization has presented some unique problems in establishing a monitoring well network. At the site, an attempt is being made to assess the fracture characteristics through 180 ft of unconsolidated sediment. The determination that the rock can be treated as a bulk porous media has yet to be made. At the site, it appears that discrete fractured zones control the groundwater flow both in the overlying sediments and in the basalt. (See also W87-02437) (Author's abstract)
W87-02466

GROUND WATER MONITORING IN FLORIDA -- LIVING WITH HYDROLOGIC AND REGULATIVE PECULIARITIES,
Geraghty and Miller, Inc., Tampa, FL.
For primary bibliographic entry see Field 2F.
W87-02500

POINT-IN-TIME COMPARISON; AN ALTERNATIVE TO THE STATISTICAL REQUIREMENTS OF RCRA ACCEPTED BY EPA,
For primary bibliographic entry see Field 5G.
W87-02501

POLLUTION POTENTIAL AND REAL ESTATE,
Snell Environmental Group, Inc., Lansing, MI.
For primary bibliographic entry see Field 5C.
W87-02502

PROGRESSIVE SITE EVALUATION,
O.H. Materials Co., Findlay, OH.
For primary bibliographic entry see Field 5B.
W87-02503

GUIDELINES FOR MONITORING WELL INSTALLATION,
Wisconsin Dept. of Natural Resources, Madison.
B. B. Gear, and J. P. Connelly.
IN: Proceedings of the Fifth National Symposium and Exposition on Aquifer Restoration and Ground Water Monitoring, May 21-24, 1985, The Fawcett Center, Columbus, Ohio. 1985. p 83-115, 1 fig, 1 tab, 8 ref, 4 append.

Descriptors: *Standards, *Monitoring wells, *Groundwater pollution, *Installation, Solid wastes, Waste disposal, Wisconsin, Wells, Groundwater, Geohydrology, Chemical properties, Boreholes.

The Bureau of Solid Waste Management, Wisconsin Department of Natural Resources (WDNR), has developed guidance for installing groundwater monitoring wells near existing and proposed solid waste disposal facilities in Wisconsin. The guidelines contain requirements and suggestions for designing, installing and abandoning wells and preparing reports to document groundwater monitoring wells and borings. The WDNR recognizes that the well designs recommend in the guidelines may not always be appropriate because the hydrogeologic and chemical environments can vary considerably. Therefore, the WDNR will be flexible in applying the guidelines to alternative well designs as long as the proposed wells can provide reliable hydrogeologic information and will not contribute to further groundwater contamination. (See also W87-02497) (Author's abstract)
W87-02505

DESIGN AND INSTALLATION OF DEEP MULTILEVEL PIEZOMETER NESTS IN COLUMBIA RIVER BASALTS AT THE HANFORD SITE, WASHINGTON,
Atomics International Div., Richland, WA. Rockwell Hanford Operations.
R. L. Jackson, and M. D. Veatch.
IN: Proceedings of the Fifth National Symposium and Exposition on Aquifer Restoration and Ground Water Monitoring, May 21-24, 1985, The Fawcett Center, Columbus, Ohio. 1985. p 144-168, 10 fig, 1 tab, 22 ref.

Descriptors: *Piezometers, *Monitoring, *Geohydrology, *Design standards, *Installation, *Columbia River, *Basalt, *Hanford Site, *Washington, Waste disposal, Radioactive wastes, Boreholes, Waste storage, Cement, Pump tests.

The Basalt Waste Isolation Project (BWIP) was established in 1976 as part of the National Waste Terminal Storage Program, now the Office of Civilian Radioactive Waste Management. The BWIP objective is to assess the suitability of basalt as a repository medium for the long-term storage of commercial high-level radioactive waste. As part of the hydrogeologic characterization activities, BWIP designed and installed multilevel piezometer nests at three borehole cluster sites within and adjacent to the 18-square mile reference repository location. These borehole cluster sites will provide multilevel piezometric baseline data across the reference repository location prior to, during, and after drilling a large-diameter exploratory shaft. They will also be used to monitor future hydraulic stress tests on a large scale. Three series of piezometer nests (A-, C-, and D-series) were installed at three borehole cluster sites in nine hydrogeologic units from a depth of about 500 to 3,700 feet within the Columbia River Basalt Group. These multilevel monitoring zones are isolated from each other and the next overlying hydrogeologic unit by high-density cement seals. The A-series piezometer nests monitor two shallow sedimentary units. The C-series piezometer nests monitor basalt flow tops in the six deepest zones. The D-series piezometer monitors an intermediate sedimentary unit. Each piezometer tube was developed by air-lift pumping to complete the installation prior to installing downhole pressure transducers. (See also W87-02497) (Author's abstract)
W87-02508

MONITORING WELLS - CHICAGO TARP,
Metropolitan Sanitary District of Greater Chicago, IL.
For primary bibliographic entry see Field 2F.
W87-02509

FACTORS REQUIRING RESOLUTION IN INSTALLING VADOSE ZONE MONITORING SYSTEMS,
Woodward-Clyde Consultants, Santa Ana, CA.
G. A. Robbins, and M. M. Gemmell.
IN: Proceedings of the Fifth National Symposium and Exposition on Aquifer Restoration and Ground Water Monitoring, May 21-24, 1985, The Fawcett Center, Columbus, Ohio. 1985. p 184-196, 3 fig, 1 tab, 5 ref.

Descriptors: *Vadose zone, *Monitoring wells, *Installation, Regulations, Standards, Groundwater quality, Water quality control, Path of pollutants, Fate of pollutants, Measuring instruments, Geophysics.

Increasingly, regulations by federal, state and local agencies are being developed that require the installation of vadose zone monitoring systems for hazardous chemical facilities in addition to, or in lieu of, conventional groundwater monitoring wells. Compared to a groundwater monitoring approach, vadose zone monitoring systems may permit earlier detection of chemical leakage and less costly clean up of contamination. The effective use of vadose zone monitoring systems in detecting contamination depends on many factors. Without proper consideration of these factors, a vadose zone monitoring system may not give as high a level of reliability as a groundwater monitoring system. Major factors to consider in installing a vadose zone monitoring system are: type of instruments and frequency of monitoring. Means to evaluate these factors in a comprehensive fashion have been lacking. Based on recent experience in installing and operating vadose zone monitoring systems, criteria and methods useful in resolving the above factors have been developed. Types of instruments can be classified as either direct (lysimeter, vapor probe) or indirect (tensiometer, conductivity probe). A combination of the two is needed for reliability. The depth, location and number of instruments depend on the geometry of the facility, the number and size of likely contaminant leakage points in engineered barriers, properties of the material being monitored, the effective radius of monitoring for each instrument, vadose zone properties, and types of remedial actions that are available. The frequency of monitoring largely depends on the rate of movement of the contaminant. Evaluating the above factors requires some level of modeling and preliminary field testing. (See also W87-02497) (Author's abstract)
W87-02510

COMPARISON OF SAMPLING MECHANISMS AVAILABLE FOR SMALL-DIAMETER GROUND WATER MONITORING WELLS,
IEP, Inc., Worthington, OH.
D. M. Nielsen, and G. L. Yeates.
IN: Proceedings of the Fifth National Symposium and Exposition on Aquifer Restoration and Ground Water Monitoring, May 21-24, 1985, The Fawcett Center, Columbus, Ohio. 1985. p 237-270, 8 fig, 13 tab, 18 ref.

Descriptors: *Water sampling, *Groundwater quality, *Monitoring wells, Aquifers, Sampling devices, Design standards.

The objective of most groundwater quality monitoring programs is to obtain samples that are 'representative' or that retain the physical and chemical properties of the groundwater in an aquifer. Many factors can influence whether or not a particular sample is representative, but perhaps the most critical factor is the method or type of sampling device used to retrieve the sample. In selecting a sampling device for a monitoring program, the professional must consider a number of details. Among the considerations are: the outside diameter of the device, the overall impact of the device on groundwater sample integrity (including the materials from which the sampling device and associated equipment are made and the method by which the device delivers the sample), the capability of the device to purge the well of stagnant water, the rate and the ability to control the rate at which the sample is delivered, the depth limitations of the device, the ease of operating, cleaning and maintaining the device, the portability of the device and required accessory equipment, the reliability and durability of the device, and the initial and operational cost of the device and accessory equipment. Based on these considerations, each of the devices available for sampling groundwater from small-diameter wells has its own unique set of advantages and disadvantages that make it suitable for sampling under specific sets of conditions. No one sampling device is applicable to all sampling situations. (See also W87-02497) (Lantz-PTT)
W87-02512

GEOPHYSICAL DETECTION OF GRAVEL CHANNELS IN UNCONSOLIDATED SEDIMENTS,
NUS Corp., Pittsburgh, PA.
For primary bibliographic entry see Field 2F.
W87-02517

SUBSURFACE HYDROCARBON VAPORS: LOW LEVEL SAMPLING AND ANALYTICAL TECHNIQUES APPLICABLE TO THEIR IDENTIFICATION/MITIGATION,
Groundwater Technology, Inc., Chadds Ford, PA.
For primary bibliographic entry see Field 5B.
W87-02526

UNSATURATED ZONE MONITORING AND RECOVERY OF UNDERGROUND CONTAMINATION,
Terra Vac, Inc., Dorado, PR.
For primary bibliographic entry see Field 5G.
W87-02532

7C. Evaluation, Processing and Publication

VARIABILITY OF DENSITY ESTIMATES AND THE OPTIMIZATION OF SAMPLING PROGRAMS FOR STREAM BENTHOS,
McGill Univ., Montreal (Quebec). Dept. of Biology.
For primary bibliographic entry see Field 7A.
W87-01807

MAPPING PALEOCHANNELS IN FLUVIAL DEPOSITS THROUGH THE APPLICATION OF GEOTECHNICAL STRATIGRAPHY,
For primary bibliographic entry see Field 2E.
W87-01841

CLASSIFICATION OF THE QUALITY OF SURFACE WATERS BY MEANS OF PATTERN RECOGNITION,
Katholieke Univ. Nijmegen (Netherlands). Dept. of Analytical Chemistry.
For primary bibliographic entry see Field 5A.
W87-01860

IMPROVEMENT OF THE REPRESENTATION OF WATER QUALITY BY APPLICATION OF INFORMATION THEORY,
Katholieke Univ. Nijmegen (Netherlands). Dept. of Analytical Chemistry.
For primary bibliographic entry see Field 5A.
W87-01861

WATIN - A COMPUTER PROGRAM FOR GENERATING INPUT FILES FOR WATEQF,
Virginia Univ., Charlottesville. Dept. of Environmental Sciences.
C. O. Moses, and J. S. Herman.
Ground Water GRWAAP, Vol. 24, No. 1, p 83-89, January-February 1986. 2 fig, 1 tab, 7 ref, append.

Descriptors: *Computer programs, *Data storage and retrieval, *Fortran, *Data interpretation, Geochemical models, Saturation, Speciation.

WATIN is a FORTRAN 77 program for creating and modifying input files of analytical data for WATEQF, the aqueous geochemical speciation/saturation model. WATIN uses menus to display information about the data file and to accept new information from the user. In addition to providing basic editing functions, WATIN provides default values for WATEQF parameters and checks for errors and inconsistencies in the data file. WATIN simplifies and streamlines access to WATEQF for both researchers and students, and along with WATEQF, can be an important part of a geochemical data analysis system. (Author's abstract)
W87-01880

COMPARATIVE ANALYSIS OF TECHNIQUES FOR SPATIAL INTERPOLATION OF PRECIPITATION,
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2B.
W87-01909

OPTIMAL IDENTIFICATION OF MUSKINGUM ROUTING COEFFICIENTS,
North Carolina Univ. at Charlotte. Dept. of Civil Engineering.
J. S. Wu, E. L. King, and M. Wang.
Water Resources Bulletin WARBAQ, Vol. 21, No. 3, p 417-421, June 1985 4 fig, 3 tab, 7 ref.

Descriptors: *Flood routing, *Statistics, *Hydrographs, Muskingum routing coefficients, Graphical method, Hydrologic problems.

Traditionally, identification of the Muskingum routing coefficients has been based on observations of the linearity of a loop formed by graphically plotting a forward and a reverse path. This graphical procedure is time-consuming and may not minimize the error of estimation. A procedure was developed to improve the drawbacks of the graphical method. This procedure calls for the use of least square regression on the forward and reverse paths to determine their respective slopes, and the use of statistical t-test to evaluate the hypothesis that these two slopes are equal. The computational procedure is repeated, using incremental values of the flow weighting coefficient, x. A graph of the computed t-value versus x can be constructed. The optimal value of x, as read from the graph, occurs at the minimum computed t-value. The procedure was applied to three examples. The first example was taken from the 'Handbook of Applied Hydrology' (Chow, 1964). The second example was taken from the text 'Hydrology for Engineers' (Linsley, et al, 1982). The third example was taken from a homework problem from the text 'Water Resources Engineering' (Linsley and Franzini, 1979). The procedure is superior to the graphical method for the three examples, resulting in a reduction of the error squares by factors ranging from 5 to 6. Although in many cases the errors encountered in field measurements of flow could be greater than results obtained by using a better fit procedure for flow routing, it is felt that a systematic and simple approach of parameter estimation is essential to practical uses for hydrologic problems. The three examples cited in this paper include hydrographs consisting of well-defined single peaks; therefore, the procedure may have its limitation when it is extended to hydrographs of multiple peaks. (Peters-PTT)
W87-01913

USING LANDSAT DATA TO CLASSIFY LAND USE FOR ASSESSING THE BASINWIDE RUNOFF INDEX,
Florida Univ., Gainesville. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 4A.
W87-01928

DERIVATION OF LAND QUALITIES TO ASSESS ENVIRONMENTAL PROBLEMS FROM SOIL SURVEYS,
Stichting voor Bodemkartering, Wageningen (Netherlands). Dept. of Soil Chemistry.
A. Breeuwsma, J. H. M. Wosten, J. J. Vleeshouwer, A. M. van Slobbe, and J. Bouma.
Soil Science Society of America Journal SSSJD4, Vol. 50, No. 1, p 186-190, January-February 1986. 4 fig, 5 tab, 13 ref.

Descriptors: *Digitized maps, *Maps, Mapping, *Soil surveys, *Travel times, *Cation exchange capacity, *Phosphate sorption capacity, *Soil texture, *Organic matter, *Aluminum, *Iron, *Land classification, Sand, Spatial variability, Soil chemistry, Computer mapping, Water table, Environmental impact assessment, Netherlands.

A digitized soil map (scale 1:50,000) of a sandy area of 2,000 ha in the Netherlands was used to derive interpretive maps showing gradations of three land qualities of importance in assessing environmental problems (travel times of water, cation exchange capacity (CEC), and phosphate sorption capacity (PSC)). Transfer functions were defined relating soil characteristics (texture, organic matter

content, and oxalate-extractable Al and Fe, integrated across horizons designations) to land qualities. Water table levels were defined in terms of the mean highest and the mean lowest levels. Land qualities were expressed in terms of classes that spanned a range of observed spatial variability. The interactive graphics computer system employed can produce interpretive maps from the soil maps almost instantly, given selected inputs such as specified water table levels. (Author's abstract)
W87-01995

ESTIMATING SOIL WATER CHARACTERISTICS FROM SIMPLER PROPERTIES OR LIMITED DATA,
Agricultural Research Service, Durant, OK. Water Quality and Watershed Research Lab.
For primary bibliographic entry see Field 2G.
W87-02034

ATMOSPHERIC DEPOSITION TO REMOTE RECEPTORS: III. STATISTICAL ANALYSIS OF PRECIPITATION DATA FROM THE ILWAS-NETWORK,
Rensselaer Polytechnic Inst., Troy, NY. Dept. of Chemical and Environmental Engineering.
For primary bibliographic entry see Field 2B.
W87-02199

SYSTEMATIC APPROACH FOR EVALUATING THE QUALITY OF GROUND WATER MONITORING DATA,
Kennedy/Jenks Engineers, San Francisco, CA.
J. A. Campbell, and W. R. Mabey.
IN: Proceedings of the Fifth National Symposium and Exposition on Aquifer Restoration and Ground Water Monitoring, May 21-24, 1985, The Fawcett Center, Columbus, Ohio. 1985. p 271-282, 2 tab, 5 ref.

Descriptors: *Groundwater quality, *Monitoring, *Data interpretation, Management planning, Boreholes, Performance evaluation, Statistical studies, Field tests, Information exchange.

The recognition and assurance of the quality of groundwater monitoring data are crucial to the correct assessment of the magnitude and extent of a groundwater contamination problem. This paper addresses an approach being developed to systematically evaluate the quality of a given set of groundwater monitoring data collected during site investigation/remedial action efforts. The system consists of a checklist of criteria, grouped into four major categories, which can be applied to laboratory or field measurements. The first category, basis of measurement, considers whether the appropriate sampling, boring, and/or analytical methods were chosen to obtain the measurement and the limitations of each method. Secondly, application of the method is assessed. This includes examination of the extent to which procedures were correctly performed, the use of quality control measures and calibration, and possible sources of error in the measurements. Third, evaluation of applied statistical methods is made, with consideration of which statistics are meaningful in a given context and whether measurements are reproducible. The final category, corroborative information, considers whether independent data or other information are available that add credibility to the values measured. In this approach, a 'high quality' data value is defined as one in which accuracy is supported by meeting the above criteria. When accompanied by precision information, high quality data allow for defensible assessments and actions. This evaluation system is useful in developing monitoring programs and in guiding documentation of field and laboratory methods during data collection. It relies heavily on experienced judgement and can be a catalyst for beneficial exchange of knowledge and ideas among groundwater professionals. (See also W87-02497) (Author's abstract)
W87-02513

8. ENGINEERING WORKS

8A. Structures

MISSISSIPPI-ATCHAFALYA DIVERSION: A NEW PERSPECTIVE,
For primary bibliographic entry see Field 6B.
W87-01843

SUPPLY SIDE ENGINEERING,
For primary bibliographic entry see Field 6B.
W87-02261

MICROTUNNELING: NO PIPE DREAM,
For primary bibliographic entry see Field 8C.
W87-02262

INSTANT HYDRO FORECASTING,
For primary bibliographic entry see Field 8C.
W87-02263

SALINE WATER USE IN POWERPLANTS - CASE STUDIES,
Bureau of Reclamation, Denver, CO.
For primary bibliographic entry see Field 3C.
W87-02493

SUBSURFACE POLLUTION CONTAINMENT USING A COMPOSITE SYSTEM VERTICAL CUT-OFF BARRIER,
Wehran Engineering Corp., Middletown, NY.
G. W. Druback, and S. V. Arlotta.
IN: Proceedings of the Fifth National Symposium and Exposition on Aquifer Restoration and Ground Water Monitoring, May 21-24, 1985, The Fawcett Center, Columbus, Ohio. 1985. p 400-411, 6 fig.

Descriptors: *Containment systems, *Cutoffs, *Materials engineering, *Groundwater pollution, *Water pollution control, Water quality control, Polyethylene, Sand, New Brunswick, Barriers, New Jersey, Landfill, Leachates.

The migration of polluted groundwater or leachate from contaminated sites or waste disposal areas, especially abandoned or 'orphan' sites, is an environmental problem of national proportions. A new and unique composite construction system has been developed to construct a vertical barrier to prevent this migration. The system is a hybrid cut-off wall, which is constructed with high density polyethylene (HDPE) and sand backfill, and installed by using the slurry trench construction method. Once installed, a very low permeability composite barrier is established with several unique engineering properties. The overall concept and construction methodology was demonstrated during a full scale construction test at a sanitary landfill in New Brunswick, New Jersey during the Fall of 1982. The test was planned to demonstrate the feasibility of the techniques and materials used to construct this composite system under generally difficult (by design) conditions. The test also demonstrated the major advantages of the system over other types of cut-off wall construction. The composite system essentially functions as a cut-off wall with redundant features for controlling horizontal seepage. A 100 mil HDPE sheet is used to form an envelope which lines the walls of an excavated trench. The bentonite slurry used during construction keeps the trench stable for placement of the HDPE sheet and sand backfill and also forms a filter cake on the walls of the trench. This filter cake further decreases the permeability of the composite in-place system. The sand backfill, beside serving as ballast, provides an internal, porous medium for monitoring seepage and, if necessary, withdrawal of intruding pollutants. (See also W87-02497) (Lantz-PTT)
W87-02521

HYDRAULIC MODEL STUDIES OF FUSE PLUG EMBANKMENTS,
Bureau of Reclamation, Denver, CO. Engineering and Research Center.
For primary bibliographic entry see Field 8B.
W87-02546

8B. Hydraulics

NUMERICAL CALCULATION OF TURBULENT CORNER FLOWS,
Imperial Coll. of Science and Technology, London (England). Computational Fluid Dynamics Unit.
J. O. Ilegbusi.
Applied Mathematical Modelling AMMODL, Vol. 9, No. 4, p. 263-270, August 1985. 15 fig, 25 ref.

Descriptors: *Turbulent flow, *Hydrodynamics, *Mathematical models, Square ducts, Flow velocity, Mathematical analysis, Mathematical studies, Eddies, Hydraulic structures, Statistical studies.

Numerical predictions are presented of the hydrodynamic characteristics of developing and fully-developed turbulent flows in a square duct. The turbulent stresses in the plane to the cross-section, gradients of which cause the familiar secondary flows, are approximated by gradients in the axial mean velocity. Two distinct approximations are investigated, one of which specifies some of the model constants as functions of the gradient of the length scale to account for wall effects. The stresses in the axial momentum equation are calculated from an eddy viscosity deduced from the K-W model of turbulence, K being the turbulence energy, and W a measure of the time-mean-square-vorticity fluctuations. The approximation incorporating wall effects generally performs better than the other when compared with fully-developed flow data. This same approximation also compares favorably with data for developing flow and predictions based on K-(dissipation rate of K) models in the literature. (Author's abstract)
W87-01833

MODIFIED, TRAPEZOIDAL VENTURI CHANNEL,
Ecole Polytechnique Federale de Lausanne (Switzerland). Dept. de Genie Civil.
W. H. Hager.
Journal of Irrigation and Drainage Engineering JIDEDH, Vol. 112, No. 3, p 225-241, August 1986. 9 fig, 1 tab, 9 ref.

Descriptors: *Venturi channels, *Channels, *Flow measurement, *Flow characteristics, *Channel flow, Flow, Open channels, Hydraulics, Flow pattern, Flow rates, Flow discharge, Critical flow.

The flow pattern resulting from a circular cone immersed in a rectangular channel is investigated under critical flow conditions. The apparatus may be used for both permanent and mobile discharge evaluation in open channels. The modified Venturi Channel may be regarded as a useful instrument owing to the low weight, the high precision of finishing, and its reasonable price when compared to the conventional structures. The circular cone is particularly well suited to watercourses in which discharge spectrum is considerable, thereby resulting in moderate approaching flow depth variation. Its rating curve is investigated by accounting for streamline curvature effects. Experiments corroborate the theoretical predictions and indicate that the flow characteristics are governed by the Froude similarity law. (Author's abstract)
W87-01952

MICROCOMPUTER SIMULATION OF CANAL OPERATION,
Hydrologic Engineering Center, Davis, CA.
D. L. Hamilton, and J. J. DeVries.
Journal of Irrigation and Drainage Engineering (ASCE) JIDEDH, Vol. 112, No. 3, p 264-273, August 1986. 5 fig, 12 ref.

Descriptors: *Computer models, *Canals, *Hydraulic similitude, *Hydraulic models, *Model studies, *Canal design, Hydraulics, Channels, Aqueducts, Model testing, Unsteady flow, Flow, Computer programs.

A computer model for the simulation of canal operations was developed using the equations for unsteady flow in open channels. The model is in generalized form, and can be applied to most non-branching canal systems composed of a series of channels separated by control structures. The programming language used is BASIC, suitable to most microcomputers. The program code can easily be modified to include special features such as automatic controllers for the canal gates. A possible improvement could be a better description of flow through a radial gate. The present solution scheme experiences unstable internal boundary conditions if the difference in water levels across the check becomes too small. The Delta Field Division Canal of the California Aqueduct was used for an example simulation and verification; there was good agreement between data computed by the model and observed data. The usefulness of models such as this will increase as canal systems are required to make deliveries on demand and as the efficient delivery of water becomes more important. Simulating alternative operational schemes would permit the determination of the most efficient method that does not endanger the integrity of the canal. (Doria-PTT)
W87-01955

VELOCITY PROFILES AND FRICTION FACTOR RELATIONSHIPS FOR TURBULENT FLOW IN SMOOTH PIPES-A REASSESSMENT OF SOME EARLIER MIXING LENGTH ASSUMPTIONS,
Aberdeen Univ. (Scotland). Dept. of Engineering.
G. D. Matthew.
Institution of Civil Engineers Proceedings PCIEAT, Vol. 81, Part 2, p 277-290, June 1986. 1 fig, 1 tab, 15 ref.

Descriptors: *Flow velocity, *Flow friction, *Pipe flow, *Turbulent flow, Mathematical equations, Shear stress, Probabilistic process, Mathematical studies.

A composite mixing length assumption is examined and used to obtain an analytical description of the complete, time-averaged velocity profile from the wall to pipe axis in a fully developed turbulent flow in a smooth pipe. A compatible friction factor-Reynolds number relationship is also derived. (Michael-PTT)
W87-02122

RESONANT SLOSHING IN SHALLOW WATER,
Oxford Univ. (England). Mathematical Inst.
H. Ockendon, J. R. Ockendon, and A. D. Johnson.
Journal of Fluid Mechanics JFLSA7, Vol. 167, p 465-479, June 1986. 15 fig, 14 ref.

Descriptors: *Mathematical equations, *Wave action, *Resonance, *Shallow water, Mathematical models, Mathematical studies, Differential equations, Dispersion, Water depth.

The derivation of equations to represent the effect of forced water waves on shallow water near resonsnce is examined. The governing ordinary differential equation is presented and its behavior recapitulated in the non-dispersive case. Asymptotic representations of the periodic response for small, non-zero water depth are presented and dissipation effects that modify these results are described. (Michael-PTT)
W87-02130

REGULAR AND MACH REFLECTION OF SHOCK WAVES,
Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt e.V., Goettingen (Germany, F.R.).
H. Hornung.
Annual Review of Fluid Mechanics ARVFA3, Vol. 18, p 33-58, 1986. 24 fig, 39 ref.

Descriptors: *Shock waves, *Hydraulics, *Hydrodynamics, Mathematical equations, Wave action, Viscosity, Reflectance, Steady flow, Statistical analysis, Shock loads, Conduction, Boundary conditions, Mathematical models.

Several effects are identified that cause pseudosimilarity of shock reflection to be broken when an independent length scale is introduced. Material properties, shock-jump relations and reflection of a plane shock from a plane surface in steady and pseudosteady inviscid flows are considered. The differences in reflection configurations that result from the effects of shock-jump relations are discussed. The reasons for occurrence of double Mach reflection, effects due to wall boundary conditions and inviscid unsteady and real-gas effects are also presented. Effects due to shear viscosity and heat conduction are most important because they strongly influence the interpretation of nominally pseudosteady results. A solution for the effect of viscosity on the triple-point path illustrates how such misinterpretations might occur. (Michael-PTT)
W87-02223

GRAVITY CURRENTS IN ROTATING SYSTEMS,
Australian National Univ., Canberra. Research School of Earth Sciences.
For primary bibliographic entry see Field 2E.
W87-02224

WIND-WAVE PREDICTION,
California Univ., Berkeley. Dept. of Civil Engineering.
R. J. Sobey.
Annual Review of Fluid Mechanics ARVFA3, Vol. 18, p 149-172, 1986. 1 fig, 56 ref.

Descriptors: *Prediction, *Mathematical models, *Wind waves, Mathematical equations, Radiative transfer, Wave action, Wave propagation.

Three commonly used approaches for wind wave prediction are described with particular emphasis on the radiative transfer equation as a rational framework for predicting wind wave generation, evolution and dissipation. The effectiveness of wind wave prediction using the empirical, discrete spectral and parametric approaches is evaluated in terms of the effects of atmospheric forcing, wind-wave interactions and wave dissipation. Uncertainties still remain when predictions are attempted using any one or a combination of these approaches. The interaction of uncertainties in physical processes, in the numerical algorithm and in initial and boundary conditions contribute to potential uncertainty. The reported success of most radiative transfer equation models indicates that the capability for wind wave prediction currently exists. (Michael-PTT)
W87-02225

THREE-DIMENSIONAL AND UNSTEADY BOUNDARY-LAYER COMPUTATIONS,
Office National d'Etudes et de Recherches Aerospatiales, Toulouse (France).
J Cousteix.
Annual Review of Fluid Mechanics ARVFA3, Vol. 18, p 173-196, 1986. 10 fig, 55 ref.

Descriptors: *Boundary conditions, *Flow measurement, *Unsteady flow, *Mathematical equations, Turbulent flow, Mathematical models, Laminar flow, Hydraulic models, Hydrodynamics.

Three problems relating to three-dimensional and unsteady boundary layer computations are examined. The first involves development of a numerical scheme for solving equations, the choice and construction of a coordinate system, particularly for the three-dimensional case, and determination and prescription of initial and boundary conditions. The second problem is the occurrence of singularities in boundary-layer computations. In two-dimensional flow, calculations stop at the zero-skin-friction point, which is singular. This is not as clear in three-dimensional and unsteady flow conditions, but recent analytical and numerical results give a more coherent picture of possible singularities. Laminar flow studies have also demonstrated that singularity depends on choice of inputs and that inverse methods permit its removal. Extension of these techniques to three-dimensional and unsteady flows is discussed. The third problem is the turbulence modeling needed to solve basic equations in turbulent flow. Although several methods are reviewed, this question remains unresolved. (Michael-PTT)
W87-02226

CRITICAL LAYERS IN SHEAR FLOWS,
McGill Univ., Montreal (Quebec). Dept. of Mathematics.
S. A. Maslowe.
Annual Review of Fluid Mechanics ARVFA3, Vol. 18, p 405-432, 1986. 7 fig, 65 ref.

Descriptors: *Shear flow, *Mathematical equations, Flow characteristics, Flow pattern, Hydrodynamics, Mathematical models, Steady flow, Critical flow.

The implications of critical layers in shear flows are examined by focusing on the parallel shear flow and the influence of time dependence, nonlinearity and dissipative effects. The nonlinear critical layer is described by using the almost inviscid theory. Applications in geophysical flow dynamics are presented and steady or quasi-steady nonlinear critical layers, initial value problems with forcing and free modes with critical layers are considered. Wave mean flow interaction at a critical level is reviewed and the need for greater numerical resolution, particularly in the stratified case, is emphasized. (Michael - PTT)
W87-02227

FIELD DETERMINATION OF THE THREE-DIMENSIONAL HYDRAULIC CONDUCTIVITY TENSOR OF ANISOTROPIC MEDIA: 1. THEORY,
Geological Survey, Menlo Park, CA.
For primary bibliographic entry see Field 2F.
W87-02278

FIELD DETERMINATION OF THREE-DIMINSIONAL HYDRAULIC CONDUCTIVITY TENSOR OF ANISOTROPIC MEDIA: 2. METHODOLOGY AND APPLICATION TO FRACTURED ROCKS,
Geological Survey, Menlo Park, CA.
For primary bibliographic entry see Field 2F.
W87-02279

MODELS FOR EVALUATING FLOW CONVEYANCE RELIABILITY OF HYDRAULIC STRUCTURES,
Wyoming Water Research Center, Laramie.
Y.-K. Tung.
Water Resources Research WRERAQ, Vol. 21, No. 10, p 1463-1468, October 1985. 3 fig, 1 tab, 23 ref.

Descriptors: *Hydraulic models, *Conveyance structures, *Structural behavior, Model studies, Hydraulic structures, Structural models, Structural engineering.

Two generalized dynamic reliability models considering both inherent hydrologic and hydraulic uncertainties were developed. The two models can be reduced to the conventional risk models which only consider hydrologic uncertainty. This development is one step forward in reaching a more complete and general model for evaluating risk and reliability of hydraulic structure design. Furthermore, the models provide insight into the interaction among the safety factor, design return period, expected service life of hydraulic structures, and statistical characteristic of resistance and loading and their effects on the total risk. Numerical examples are presented in the paper to compare relative performance of the conventional risk models and the generalized models developed herein. It is generally observed that hydraulic uncertainty can be ignored in risk evaluation when its level is moderate or large. Furthermore, a higher price, in terms of a larger value of safety factor, is needed to improve risk level when the hydraulic uncertainty is large relative to hydrologic uncertainty. (Lantz-PTT)
W87-02378

HYDRAULIC MODEL STUDIES OF FUSE PLUG EMBANKMENTS,
Bureau of Reclamation, Denver, CO. Engineering and Research Center.
C. A. Pugh.
Available from the National Technical Information Service, Springfield, VA. 22161. as PB86 233277, A03 in paper copy, A01 in microfiche. Report REc-ERC-85-7, December 1985. 33 p, 32 fig, 3 tab, 10 ref.

Descriptors: *Hydraulic models, *Reservoir management, *Flood control, *Fuse plugs, *Embankments, Model studies, Flow control, Reservoir releases, Erosion rates, Mathematical analysis.

Hydraulic model studies were conducted to help develop guidelines for designing fuse plugs where these structures would be appropriate for controlling reservoir outflows from large floods with long return periods. Model embankments at scales of 1:10 and 1:25 simulated prototype fuse plugs from 10 to 30 ft (3 to 9 m) high. Eight tests were conducted for a variety of embankments and flow conditions. The erosion rates and discharge coefficients determined in this study can be used in computer flood-routing programs to aid in the design of fuse plug embankments and to assess the effects of various options. The sand filter, embankment material, and material gradation were found to have significant effects on the rate of erosion. It was also found that the configuration of the approach channel has a significant effect on the hydraulics of the flow through the fuse plug and on the erosion rate. The study concluded that: 1) A properly designed fuse plug embankment will wash out in an orderly and predictable manner when additional flow capacity is needed to pass a large flood through a reservoir. The fuse plug will preclude the use of the auxiliary spillway during small floods; 2) The lateral erosion rate (after the initial breach) is primarily a function of the erosion rate of the embankment material and not a function of the strength of the impermeable core; 3) The erosion rates and discharge coefficients determined in this study can be used in flood-routing computer programs to help design fuse plug embankments; 4) Ratios of depth of water to embankment height and depth of water to weir width have significant effects on erosion rates; and 5) The sand filter, embankment material, and gradation have significant effects on erosion rates. A model design method is described that compensates for the fact that the Reynolds number is normally too low to properly simulate sediment tranport in a Froude scale hydraulic model. This method uses settling velocity adjustments and dimensionless unit sediment discharges to adjust the model grain sizes and/or the model sediment density. (Lantz-PTT)
W87-02546

PRESSURE CALCULATION FOR TWO-DIMENSIONAL FLOW INSIDE HYDRAULIC STRUCTURES,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.
R. S. Bernard.
Available from the National Technical Information Service, Springfield, VA. 22161 as ADA 169039, A03 in paper copy, A01 in microfiche. Miscellaneous Paper HL-86-2, April 1986. Final Report. 33 p, 19 fig, 4 ref, 2 append.

Descriptors: *Pressure distribution, *Computer models, *Flow pattern, *Hydraulic structures, Flow velocity, Flow profile, Mathematical studies, Navier-Stokes equation, Vortices, Piezometry, Cavitation, Computers.

A method has been developed for computing two-dimensional pressure distributions inside hydraulic structures. Velocities are first obtained by finite difference solution of the Navier-Stokes equations in stream function/vorticity form. Pressure is then calculated by numerical integration of the momentum equation. The method has been incorporated for arbitrary geometry in the VORTEX computer code, which uses boundary-fitted grids generated by the WESCOR code. Computed results compare well with piezometric data from physical-model tests for the Taylorsville outlet works, indicating that the VORTEX code may be useful in identifying and eliminating flow conditions that promote cavitation. (Author's abstract)
W87-02551

8C. Hydraulic Machinery

FUNDY TIDAL POWER DEVELOPMENT AND POTENTIAL FISH PRODUCTION IN THE GULF OF MAINE,
Maine State Dept. of Marine Resources, West Boothbay Harbor.
For primary bibliographic entry see Field 4A.
W87-01822

THROTTLE HOSE, AN AUTOMATIC DIVERSION DEVICE WITH CONSTANT DISCHARGE FOR IRRIGATION CHANNELS (LE MANCHON SOUPLE D'ETRANGLEMENT, OGANE AUTOREGULATEUR DE REPARTITION DE DEBITS CONSTANTS DANS LES CANAUX D'IRRIGATION),
Eidgenoessische Technische Hochschule, Zurich (Switzerland). Versuchsanstalt fuer Wasserbau, Hydrologie und Glaziologie.
For primary bibliographic entry see Field 3F.
W87-01968

OPERATION AND MAINTENANCE OF UNDERGROUND INJECTION WELLS,
Du Pont de Nemours (E.I.) and Co., Victoria, TX.
For primary bibliographic entry see Field 5E.
W87-02056

PROBABILISTIC APPROACH TO THE STABILITY ANALYSIS OF ROCK PROTECTION FOR EARTH WEIRS,
Southampton Univ. (England). Dept. of Hydraulic Engineering.
For primary bibliographic entry see Field 8G.
W87-02120

PRECISION ALIGNMENT METHOD BOOSTS HYDROTURBINE PERFORMANCE,
M. Crahan, and D. Gettman.
Power, Vol. 130, No. 7, p 45-47, August 1986. 5 fig.

Descriptors: *Hydraulic turbines, *Pumped storage, *Power plants, *Turbine alignment, *TUCE technique, Mechanical equipment, Mechanical engineering, Los Angeles Department of Water and Power.

A total unit centerline erection (TUCE) technique for alignment of hydroturbine generators is reviewed. The advantages of using TUCE over conventional methods are highlighted. Procedures for optical alignment of both stationary and rotating elements are described and the results of applying the technique at the Los Angeles Department of Water and Power's Castaic generating unit are listed. (Michael-PTT)
W87-02127

GURI'S 10,000 MW READY TO ROLL,
W. G. Reinhardt.
Engineering News Record, Vol. 317, No. 3, p 36-37, July 17, 1986.

Descriptors: *Hydroelectric plants, *Venezuela, *Guri, *Cost Analysis, *Construction, Construction costs, Dams, Economic development.

An overview of staged planning, construction costs and economic benefits associated with the $5.2 billion Guri hydroelectric project in Venezuela is presented. (Michael-PTT)
W87-02128

MICROTUNNELING: NO PIPE DREAM,
J. C. Thomson.
Civil Engineering, Vol. 56, No. 8, p 56-59, August 1986. 4 fig.

Descriptors: *Pipes, *Tunneling, *Construction methods, Construction costs, Construction equipment, Japan, West Germany, Water transport.

A technique for trenchless pipelaying using microtunneling techniques as applied in West Germany and Japan is described. Equipment requirements, tunneling methods and relative costs and benefits of microtunneling are discussed. In the developed Western countries and Japan, 31,000 miles of sewer in the 12 to 36 in. diameter range are installed each year. Perhaps 25% could be favorable to microtunneling. This is 7,800 miles, and with a competitive average price of $100 ft, there is a $4 billion potential market. (Michael-PTT)
W87-02262

INSTANT HYDRO FORECASTING,
A. Dotan, and D. C. Willer.
Civil Engineering, Vol. 56, No. 8, p 60-63, August 1986. 4 fig.

Descriptors: *Hydroelectric plants, *Computer programs, Hysize, Hystor, Reservoirs, Reservoir siting, Planning, Economic evaluation.

Two computer programs, Hysize for run-of-river type projects and Hystor for sites with reservoirs, are reviewed in terms of their ability to determine optimum layout for a particular hydroelectric site, rank alternatives in order of economic priorities and test the sensitivity of assumed variables. The application of Hysize to address the planning requirements of the Griswold Creek project in northeastern California is described. Sample computer print-outs are presented. (Michael-PTT)
W87-02263

HYDROELECTRIC RESOURCE STUDIES IN TOGO AND BENIN,
For primary bibliographic entry see Field 7A.
W87-02268

STORAGE IN A DEEP AQUIFER AT HIGH TEMPERATURE. PILOT PLANT IN PLAISIR, (STOCKAGE EN NAPPE PROFONDE A HAUTE TEMPERATURE. PILOTE DE PLAISIR),
CEA Centre d'Etudes Nucleaires de Saclay, Gif-sur-Yvette (France).
For primary bibliographic entry see Field 4B.
W87-02425

HEAT STORAGE IN SURFACE WATER. THE PILOT PLANTS OF MONTREUIL AND LYON GERLAND, (STOCKAGE DE CHALEUR EN NAPPE DE SURFACE. LES PILOTES DE MONTREUIL ET DE LYON-GERLAND),
Bureau de Recherches Geologiques et Minieres, Orleans (France).
For primary bibliographic entry see Field 4B.
W87-02426

PROJECT FOR INTERSEASONAL STORAGE OF CLIMATIC CALORIES IN AN AQUIFER, (PROJET DE STOCKAGE INTERSAISONNIER DE CALORIES CLIMATIQUES EN AQUIFERE),
BURGEAP S.A., Paris (France).
For primary bibliographic entry see Field 4B.
W87-02427

SALINE WATER USE IN POWERPLANTS - CASE STUDIES,
Bureau of Reclamation, Denver, CO.
For primary bibliographic entry see Field 3C.
W87-02493

8D. Soil Mechanics

MEASUREMENT OF SHEAR STRENGTH AND BULK DENSITY OF SOIL AGGREGATES,
Iowa State Univ., Ames. Dept. of Agronomy.
J. G. Benjamin, and R. M. Cruse.
Soil Science Society of America Journal SSSJD4,

Vol. 49, No. 5, p 1248-1251, September-October 1985. 1 fig, 4 tab, 19 ref.

Descriptors: *Soil aggregates, *Soil density, *Conservation, *Strength, Fall-cone penetrometer, Gamma-ray attenuation, Soil water, Shear tests, Density, Soil stability.

A method was developed to measure soil aggregate shear strength and bulk density at soil water matric potentials < 0. Strength measurements were made with the Swedish fall-cone penetrometer, and the bulk density measurements were made by gamma-ray attenuation. This method allowed both density and strength measurements to be made on the same sample. As the matric potential decreased, the shear strength of the soil aggregates increased. The method described by this paper showed an improvement over the standard wet-sieve technique for determination of aggregate stability because it allowed the measurement of aggregate strength at matric potentials < 0. Strength measurements were in units of stress, and the aggregate density, as well as aggregate strength, could be measured for each sample. The disadvantage was that aggregates with diameters > 2 cm were required for the measurement. (Author's abstract)
W87-02039

DEVELOPMENT OF MULTIPLE SEEPAGE FACES ON LAYERED SLOPES,
British Columbia Univ., Vancouver. Dept. of Geological Sciences.
For primary bibliographic entry see Field 2F.
W87-02274

8E. Rock Mechanics and Geology

APPLICATION OF CONTINUOUS SEISMIC REFLECTION METHODS TO HYDROLOGIC STUDIES,
Geological Survey, Hartford, CT. Water Resources Div.
For primary bibliographic entry see Field 2F.
W87-01872

ENIWETOK ATOLL ISLAND: GEOTHERMAL SYSTEM IN THE NATURAL STATE, (ATOLL D'ENIWETOK: SYSTEME GEOTHERMIQUE INSULAIRE A L'ETAT NATUREL),
CEA Centre d'Etudes de Bruyeres-le-Chatel, Montrouge (France).
For primary bibliographic entry see Field 2F.
W87-01970

CONVENTIONAL AND STATE-OF-THE-ART GEOPHYSICAL TECHNIQUES FOR FRACTURE DETECTION,
Weston Geophysical Corp., Westborough, MA.
For primary bibliographic entry see Field 7B.
W87-02456

8F. Concrete

SUPPLY SIDE ENGINEERING,
For primary bibliographic entry see Field 6B.
W87-02261

ANALYSIS OF THE BUREAU OF RECLAMATION'S USE OF GROUT AND GROUT CURTAINS - SUMMARY,
Bureau of Reclamation, Denver, CO. Engineering and Research Center.
C. A. Fetzer.
Available from the National Technical Information Service, Springfield, VA. 22161. as PB86 233293, A03 in paper copy, A01 in michrofiche. Report REC-ERC-86-3, February 1986. 42 p, 4 tab, 14 ref, 3 append.

Descriptors: *Grouting, *Cements, *Materials testing, Hoover Dam, Kortes Dam, Hungry Horse Dam, Flaming Gorge Dam, Morrow Point Dam, Heron Dam, Materials engineering, Dam construction.

The foundation grouting programs of six large Bureau of Reclamation dams (Hoover Dam, Kortes Dam, Hungry Horse Dam, Flaming Gorge Dam, Morrow Point Dam, Heron Dam and Dike) were reviewed and analyzed. The purpose of this program was to analyze the use of foundation grouting at Bureau of Reclamation structures to determine the effectiveness of the grout over the service life of the dams to date. Special attention was given to preconstruction geological conditions and changed or unexpected geological conditions discovered during the grouting activities. Recommendations are presented to improve future grouting operations. (Author's abstract)
W87-02545

8G. Materials

CORROSION AND INCRUSTATION,
B. J. Graves.
Water Well Journal, Vol. 40, No. 6, p 59-60, June 1986. 1 fig, 2 ref.

Descriptors: *Corrosion, *Water wells, *Electrolysis, *Incrustation, *Sand, *Silt, *Iron bacteria, *Iron, *Steel, *Carbonate deposition, Iron carbonate, Calcium carbonate, Chemical equilibria, Physical properties, Groundwater, Dissolved gases, Ultraviolet light, Ultrasound, Pasteurization, Oxidation-reduction potential.

Corrosion is the destruction of a metal through chemical or electrochemical reaction with its environment; the type of corrosion that affects water well equipment or parts made of iron, steel, and other active metals is an electrolytic process. Corrosion reactions in groundwater environments are influenced by a numer of factors, including chemical equilibrium effects, a variety of physical factors, and the presence of dissolved minerals and gases in the water. A variety of dissolved and suspended solids may contribute to incrustation of wells, particularly the screen casing, pump, and discharge assembly. Sand and silt deposits are classed as inert incrustations, whereas carbonate deposition from two major solutes, calcium carbonate and iron carbonate, is an example of a relatively common source of chemical incrustation. Perhaps the most troublesome of incrustations are those resulting from iron bacteria, which derive nutrients and energy from ferrous compounds in groundwater. Methods for their control include ultraviolet light, ultrasonic vibration, pasteurization and changing the redox potential. (Rochester-PTT)
W87-02074

PROBABILISTIC APPROACH TO THE STABILITY ANALYSIS OF ROCK PROTECTION FOR EARTH WEIRS,
Southampton Univ. (England). Dept. of Hydraulic Engineering.
K. V. H. Smith.
Institution of Civil Engineers Proceedings PCIEAT, Vol. 81, Part 2, p 243-253, June 1986. 5 fig, 1 tab, 12 ref, append.

Descriptors: *Weirs, *Stability analysis, *Probabilistic process, *Prediction, Mathematical studies, Mathematical equations, Rock mechanics, Rockfill dams, Structural models, Failure analysis.

Data from failure tests on laboratory-scale rock protected weirs was used to predict the probability of movement of individual rocks forming the protection. Previous research on rock protection is reviewed and a safety factor based on the stability of an individual particle is postulated. The probability of movement at weir failure discharge is evaluated. Results suggest that a probabilistic approach to individual rock movement could lead to a method for determining failure discharge for a rock protected weir, but further research on transducers and rock erosion is required. (Michael-PTT)
W87-02120

EFFECTIVENESS OF A COMPACTED CLAY LINER IN PREVENTING GROUND WATER CONTAMINATION,
Science and Education Administration, University Park, PA. Northeast Watershed Research Center.
A. S. Rogowski.
IN: Proceedings of the Fifth National Symposium and Exposition on Aquifer Restoration and Ground Water Monitoring, May 21-24, 1985, The Fawcett Center, Columbus, Ohio. 1985. p 412-429, 12 fig, 5 tab, 2 ref. EPA Agreement No. DW129-303-03-01-0.

Descriptors: *Compacted soils, *Clays, *Groundwater pollution, *Water pollution control, Liners, Infiltration, Monitoring, Measuring instruments, Drainage, Data interpretation, Performance evaluation.

A study was begun in 1983 to characterize the areal variation in hydraulic conductivity of a compacted clay liner. A field-scale research facility was constructed, consisting of a 30' x 75' area of clay soil compacted in three layers to specifications commonly used in constructing clay liners. The facility was fully instrumented to measure infiltration, drainage, and soil properties at numerous data collection points. Preliminary studies were initiated using section of small barrels, and larger caissons to verify the performance of monitoring systems. Results from these preliminary studies (prototypes) have shown that any perforations of the compacted soil, such as wells or access tubing for detectors to monitor wetting front advance, result in preferential water movement along these perforations. In order to avoid this situation in the field-scale facility, access tubes were placed horizontally to accommodate the nuclear probes used to measure changes in soil density and porosity. Also, underdrains were imbedded in the concrete support structure to collect outflow, buffered infiltration cylinders were installed to monitor infiltration, and metal plates were fixed to the soil surface for assessing soil swelling through measurement of elevation changes. Quality control data obtained during construction show that the average molding water content and final dry density of the compacted clay were close to design specifications, but the spatial variability in these values was large. Infiltration rates and drainage rates obtained after ponding the field scale facility were poorly predicted by the prototype data from barrels and caissons. Initial data show breakthrough of percolate near the confining walls, a feature also observed earlier in prototype studies. The extent of clay liner integrity and observed travel times reflect the effectiveness of a field-scale clay liner in preventing possible groundwater contamination. Proper evaluation of flux rates and their distribution in time and space is necessary to characterize a clay liner. (See also W87-02497) (Author's abstract)
W87-02522

8I. Fisheries Engineering

STOCHASTIC POPULATION MODEL FOR MANAGING THE ATLANTIC MENHADEN (BREVOORTIA TYRANNUS) FISHERY AND ASSESSING MANAGERIAL RISKS,
North Carolina Univ. at Chapel Hill. Dept. of Statistics.
D. Ruppert, R. L. Reish, R. B. Deriso, and R. J. Carroll.
Canadian Journal of Fisheries and Aquatic Sciences CJFSBX, Vol. 42, No. 8, p 1371-1379, August 1985. 7 fig, 4 tab, 26 ref.

Descriptors: *Menhaden, *Fisheries, *Risk assessment, *Harvesting strategy, *Atlantic coast, *Population dynamics, Egg escapement policy, Errors, Statistics.

A model that included age-structure, a stochastic egg-recruitment relationship, density-dependent juvenile growth, age-dependent fishing mortality, and fecundity dependent upon size and age was used to investigate three types of harvestig strategies: constant yearly catch policies, constant fishing mortality rate policies, and 'egg escapement' policies, which are defined in this article. Because

of stochastic recruitment, constant yearly catch policies appear unsuitable for managing Atlantic menhaden. The other two policy types are suitable, but the egg escapement policies have higher long-term average catches. Using decision theory, the risks due to randomness and the estimation errors of the biological parameters in the model were estimated and found to be acceptable. (Author's abstract)
W87-01801

BIOLOGICAL CONTROL OF EXCESSIVE PHYTOPLANKTON GROWTH AND THE ENHANCEMENT OF AQUACULTURAL PRODUCTION,
California Univ., Santa Barbara. Dept. of Biological Sciences.
For primary bibliographic entry see Field 5G.
W87-01813

POTENTIAL USEFULNESS OF CHLORINE FOR CONTROLLING PACIFIC SALMON LEECHES, PISCICOLA SALMOSITICA, IN HATCHERIES,
Department of Fisheries and Oceans, Nanaimo (British Columbia). Fisheries Research Branch.
S. M. Bower, L. Margolis, and R. J. MacKay.
Canadian Journal of Fisheries and Aquatic Sciences CJFSBX, Vol. 42, No. 12, p 1986-1993, December 1985. 2 fig, 6 tab, 24 ref.

Descriptors: *Pacific salmon leeches, *Cryptobia salmositica, *Gills, *Pathology, *Chlorination, *Coho salmon, Fish diseases, Fish hatcheries, Juvenile growth stage, Tissue damage, Logistic regression models, Mortality.

Susceptibility to the lethal effects of low levels of total residual chlorine (TRC) differed between juvenile coho salmon (Oncorhynchus kisuth) and the salmon leech, the vector of the hemoflagellate pathogen Cryptobia salmositica. There was no salmon mortality at concentrations below approximately 50 microgram (ug) TRC/liter for the maximum exposure time of 24 hr. Some damage to gill tissue (hypertrophy, fusion edema, and some necrosis), was observed at the highest concentrations of TRC that did not kill any of the fish (approximately 50 ug/l for 24 hr and approximately 100 ug/l for 8 hr). Damage was repaired by the fish within 4 days of exposure, but evidence of past irritation was noted in 6 of 12 fish. All small juvenile leeches exposed to 44 ug TRC/l for 24 hr died, and over half of such leeches exposed to 44 ug/l for 8 hr and 21 ug/l for 24 hr died. Below TRC concentrations that were lethal to the fish (approximately 50 ug/l), contours of constant leech mortality derived from a logistic regression model fitted to the data offered a wide range of concentrations and exposure times that would result from high mortality of juvenile leeches. Larger subadult and adult leeches were more resistant to chlorine than the smaller leeches, but were more sensitive than the juvenile fish. (Author's abstract)
W87-01816

COMPARATIVE ANALYSIS OF IONOREGULATION IN RAINBOW TROUT (SALMON GAIRDNERI) OF DIFFERENT SIZES FOLLOWING RAPID AND SLOW SALINITY ADAPTATION,
Prince Edward Island Univ., Charlottetown. Dept. of Biology.
C. E. Johnston, and J. C. Cheverie.
Canadian Journal of Fisheries and Aquatic Sciences CJFSBX, Vol. 42, No. 12, p 1994-2003, December 1985. 7 fig, 1 tab, 24 ref.

Descriptors: *Blood chemistry, *Rainbow trout, *Estuaries, *Fish handling facilities, *Salinity, Sodium ions, Potassium ions, Prince Edward Island, Fortune Bay, Canada, Adenosine triphosphatase, Enzymes, Sea cages.

Plasma ion values and gill (Na(+), K(+))-ATPase activity were compared for rainbow trout of three different fork lengths (<11, 11-15, and >15 cm) following transference from freshwater as follows: (1) directly into seawater of 28-29 per mill (DTT); (2) directly into an estuarine environment at Fortune Bay (Prince Edward Island, Canada), where salinity fluctuated primarily between 17 and 29 per mill (DTF); (3) into a salinity that slowly increased to 28 per mill in 22 days (SAT); and (4) into freshwater (FC). Trout of all sizes displayed better growth, lower mortality, and better ionoregulatory capacity, as judged by plasma N(a)+, K(+), and Cl(-) concentrations and (Na(+),K(+))-ATPase activity in sea cages in Fortune Bay (DTF). The poorest ionoregulatory capacity and growth was in direct transfer from freshwater to salinity 28-29 per mill (DTT). Failure of small trout to adapt to constanly high salinity of 28-29 per mill due to slower development of (Na(+),K(+))-ATPase activity, excessively high plasma Na(+) and Cl(-) concentrations, hemoconcentration, and tissue dehydration. Except for trout severely stressed by high salinity, growth in seawater was more favorable than in freshwater. (Author's abstract)
W87-01817

OPTIMAL EFFORT ALLOCATION AMONG COMPETING MIXED-SPECIES FISHERIES, SUBJECT TO FISHING MORTALITY CONSTRAINTS,
National Marine Fisheries Service, Woods Hole, MA. Northeast Fisheries Center.
S. A. Murawski, and J. T. Finn.
Canadian Journal of Fisheries and Aquatic Sciences CJFSBX, Vol. 43, No. 1, p 90-100, January 1986. 2 fig, 4 tab, 16 ref.

Descriptors: *Linear programming, *Effort allocation, *Marine fisheries, *Georges Bank, *Mortality, *Mathematical models, Fish management, Cost analysis, Sensitivity analysis, Otter trawls, Demersal fish.

A linear programming (LP) approach to effort allocation among two or more fisheries (fleets) exploiting several common species/stocks is described and applied to otter trawl fisheries exploiting demersal fish stocks on Georges Bank (northeastern United States). Total instantaneous fishing mortality on a particular species (i) is computed as the linear summation of fishing mortalities generated by each fishery (j): F sub i = Summation of q sub ij x f sub i, where f sub i is the amount of standardized fishing effort exerted in fishery j and q sub ij is the catachability coefficient for species i taken in fishery j. Optimal allocation of effort among the j fisheries may be considered a minimization problem (minimize summation of f sub i), subject to the constraints that fishing mortality goals for individual species can be based on various biological and/or economic criteria: fishing mortality rates that prevent growth or recruitment overfishing, or that optimize productivity from predator-prey systems. Other constraints in the LP model may be included to modify optimal solutions based on various economic and social considerations (eg, protection of certain fisheries). Sensitivity analyses indicate the general infeasibility of maintaining relatively high or low fishing mortality rates on ubiquitously distributed species, while moderately fishing species with more discrete distributions, due to by-catch considerations. (Author's abstract)
W87-01823

OPTIMAL STOCK SIZE AND HARVEST RATE IN MULTISTAGE LIFE HISTORY MODELS,
British Columbia Univ., Vancouver. Inst. of Animal Resource Ecology.
E. Mousalli, and R. Hilborn.
Canadian Journal of Fisheries and Aquatic Sciences CJFSBX, Vol. 43, No. 1, p 135-141, January 1986. 3 fig, 2 tab, 20 ref.

Descriptors: *Fish populations, *Estuarine fisheries, *Coho salmon, *Sockeye salmon, *Fish harvest, *Fish stocking, *Beverton-Holt curves, Fish management, British Columbia, Kvichak River, Survival, Freshwater, Oceans.

If the life history of a fish population consists of a sequence of density-dependent stages linked by density-independent survival rates, and if the density-dependent stages take the form of the Beverton-Holt stock and recruitment curve, then a single Beverton-Holt curve will describe the entire life history. The relationship between the parameters of any stage in the life history and the optimal harvest rate and optimal stock size is analyzed. Increasing survival rates will always increase the optimal harvest rate, but may increase or decrease the optimal stock size. Increasing the habitat capacity will increase the optimal stock size and leave the optimal harvest rate unaffected. An example of changing freshwater survival rates by Salmonid Enhancement Program (coho salmon, British Columbia, Canada) is shown, as is an example of changing ocean survival rate (Bristol Bay sockeye salmon, Kvichak River system). Acquisition of a better understanding of the determinants of survival and habitat capacity should result in adjustment of harvest rates and stock size as the environment changes. (Author's abstract)
W87-01825

EFFECTS OF CHRONIC EXPOSURE TO SUBLETHAL PH ON GROWTH, EGG PRODUCTION, AND OVULATION IN BROOK TROUT, SALVELINUS FONTINALIS,
University of Western Ontario, London. Dept. of Zoology.
For primary bibliographic entry see Field 5C.
W87-01846

INFLUENCE OF SALMONINE PREDATION AND WEATHER ON LONG-TERM WATER QUALITY TRENDS IN LAKE MICHIGAN,
National Oceanic and Atmospheric Administration, Ann Arbor, MI. Great Lakes Environmental Research Lab.
For primary bibliographic entry see Field 5B.
W87-01856

TECHNIQUE FOR MEASURING SCOUR AND FILL OF SALMON SPAWNING RIFFLES IN HEADWATER STREAMS,
Weyerhaeuser Co., Tacoma, WA. Environmental Forestry Research.
For primary bibliographic entry see Field 2J.
W87-01925

MICROBIAL QUALITY OF WATER IN INTENSIVE FISH REARING,
Ministry of Agriculture, Fisheries and Food, Weymouth (England). Fish Diseases Lab.
For primary bibliographic entry see Field 5C.
W87-02220

COMMERCIAL FISH CATCHES AS AN INDEX OF LAKE EUTROPHICATION,
Instytut Rybactwa Srodladowego, Olsztyn-Kortowo (Poland).
For primary bibliographic entry see Field 2H.
W87-02335

9. MANPOWER, GRANTS AND FACILITIES

9B. Education (In-House)

TRAINING FOR WATER IN INDIA,
Ministry of Urban Development, New Delhi (India).
For primary bibliographic entry see Field 5F.
W87-02047

APPLYING ACTIVE EDUCATIONAL METHODS FOR TRAINING IN THE WATER SECTOR (LES METHODES PEDAGOGIQUES ACTIVES APPLIQUEES AUX METIERS DE L'EAU),
Compagnie Generale des Eaux, Paris (France).
P. Wattier.
Aqua AQUAA, No. 3, p 143-146, 1986. 3 fig.

Descriptors: *Training, *Active educational methods, *Computer-aided instruction, Productivity, Management planning, Organizations.

Two examples of what could be called active educational methods for training are presented. It is shown that traditional training can be greatly enhanced by using information processing (computer-aided teaching). Similarly, considerations of training needs, training, and definition of programs is a concern of each water service, not of a few education specialists. Thus, training not only becomes a tool for improvement of skills and productivity, but a tool for change within the company. (Author's abstract)
W87-02048

ENSURING THE OPERATION AND MAINTENANCE OF WATER SUPPLY SYSTEMS,
Mansfield Coll., Oxford (England).
For primary bibliographic entry see Field 5F.
W87-02049

TRAINING FOR WATER IN AFRICA, (LA FORMATION DANS LE DOMAINE DE L'EAU EN AFRIQUE),
Societe de Distribution d'Eau de la Cote-d'Ivoire, Abidjan.
For primary bibliographic entry see Field 5F.
W87-02050

MICRO-ELECTRONICS IN THE WATER INDUSTRY - THE IMPORTANCE OF PEOPLE,
Institution of Water Engineers and Scientists, London (England).
For primary bibliographic entry see Field 5F.
W87-02051

10. SCIENTIFIC AND TECHNICAL INFORMATION

10F. Preparation Of Reviews

BIOLOGICAL FATE OF ORGANIC PRIORITY POLLUTANTS IN THE AQUATIC ENVIRONMENT,
Pennsylvania Univ., Philadelphia. Dept. of Civil and Urban Engineering.
For primary bibliographic entry see Field 5B.
W87-02354

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N01	45.00	E13	35.50	D13	625.00	T13	1,300.00
N02	48.00	E14	38.50	D14	675.00	T14	1,400.00
		E15	42.00	D15	725.00	T15	1,500.00
		E16	46.00	D16	775.00	T16	1,600.00
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